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The Production of Sandalwood.

As Mr. Pigot's successor in Coorg I have naturally read with much interest your review, in the Forester of last March, of Mr Pigot's interesting reports and proposals on this subject and also his reply thereto in the October number of the magazine. It should not be lost sight of that the proposals discussed in your editorial had reference to Coorg only. Mr. Pigot had not then the Mysore experience with which the October article was written, and although it is strictly true that the conditions in Coorg are identical with *parts* of Mysore, there is I take it a not inconsiderable difference between the general conditions under which sandal is placed in the two Provinces. Take for example the most important class of land, from the sandal point of view, viz. the unreserved wastes including way sides, grazing grounds, tank bunds &c. I believe it will be admitted that the importance of the danger to sandal in it from what Mr. Pigot has aptly termed the Lantana invasion is not to be compared in the two cases. Consequently general proposals such as those which have been put forward for treating such areas would not be always suitable.

In discussing the future of sandal Mr. Pigot has added one to the three classes of lands which were previously separately considered as present or possible sources of supply. I would suggest a slight rearrangement of classes (*a*) and (*d*) and confine class (*a*) to cultivation and private lands, because special measures have been proposed for dealing with them. The classification would then run as follows :—

(*a*) Trees near cultivation and on private lands.
(*b*) Trees in reserves grown either naturally or by cultural operations aiding natural reproduction.
(*c*) Trees in regular plantations.
(*d*) Trees in all waste lands, the property of Government, including grazing grounds, roadside hedges, tank bunds, &c.,

The present and past sources of supply are practically limited to classes (*a*) and (*d*) but of these in Coorg the latter is and always has been immeasureably the most important. In fact I think the prominence given to class (*a*) has been rather out of proportion to its real position. But here again I fancy the conditions in Mysore vary, there being relatively a far larger area under cultivation there than in the Hill Province.

With reference to Mr. Pigot's important proposal to encourage reproduction in class (*a*) by offering land holders a part of the value of trees uprooted in their lands, I understand that whilst the writer of your review is in favour of the principle he finds objection to the manner of application suggested *viz. by payment at time of removal of part* value of each tree. If so I confess I am entirely of his opinion. Mr. Pigot emphasises in his October article the point that his scheme would give the ryot a compensation in cash down and not depend for its object, as remarked by the reviewer, on promises of payment to posterity. But this is only partly true. The kind of trees for which the ryots will protect for the sake of the "cash down" are those which have already attained maturity or will shortly do so, in say 10 or 15 years. The 10 % share suggested by Mr. Pigot would give the ryot about Rs. 2 to Rs. 2-4-0 per tree and with our experience of the improvident ways of the Indian ryot it is doubtful if he would take a personal interest in the acquisition of such comparatively small sums at any remoter period. Now as a matter of fact the class of tree alluded to does not want protection at all. It generally stands isolated on this kind of land and at any rate its size and known existence to the whole neighbourhood is protection enough against natural influences and surreptitious removal respectively. The class of tree which does require protection is the young growth up to 15 or 20 years of age. But in their case it will be 30 to 60* years (on lands of this quality) before the ryot receives payment, and he is likely to take little or no personal interest in them consequently their protection vanishes in the same degree.

If the above line of argument is approximately correct, it would appear that this method of remuneration would only result in the alienation of an appreciable slice of the sandal revenue of the next few years on behalf of a lot of trees which are already as safe as if they were in depot, and that it would take us no forwarder on the road to real protection. Nevertheless no one can doubt that unless the ryots are given some interest in these trees we must face the probability of steady deteriorition in this source of supply. *Although I have discussed*

* Say age of maturity 50 to 60 years. Then about 30 years in case of 20 years old trees and about 60 years in case of seedlings.

the matter with revenue officers of all grades who may be expected to know what would suit the ryots and at the same time give us a reasonable hope of success, the application of the principle has so far appeared full of practical difficulties. No doubt the problem will shortly be solved. The thing is to establish confidence in the people in our good intentions and to do so it will probably be necessary at first for the Government to take some risk. Any plan which may be subsequently approved of will be well worth close watching and this can only be done by starting and maintaining a village register of trees on such lands.

Coming to (*b*) trees growing in Reserved forests naturally or aided by cultural operations, I quite support all Mr. Pigot says regarding its being too late now for the constitution of sandal reserves from the natural sandal bearing areas. Upon the issue of recent orders to that effect in Coorg only 3 or 4 small plots varying from 3 to 5 acres each were discovered after much search and then only in the Lantana country. They were apparently abandoned fields and grazing grounds which had been seized on and appropriated by Lantana, and unless some financially practicable method of keeping the latter in check can be devised the death by suppression or fire of all the trees in them is only a question of time.

Mr. Pigot is not very hopeful of the possibility of introducing sandal into other Reserves which are situated within the sandal bearing tract, although such may appear in every way suitable for the tree. I am presuming that the forests alluded to are not simply those unsuitable to sandal from the density of the growth in them. In the early portion of the October article the opinion is expressed that, provided the forest is strictly conserved, if sandal is not already there it is because in some way the conditions are not suitable. If strict conservation includes protection from deer, I should hesitate to differ from this view, but here in Coorg at least there has been no means of testing the theory as there exist no strictly conserved forests of this description. Not to speak of the presence of deer and occasional occurrences of fire, the Reserved forests in the sandal zone are all with one exception indiscriminately open to heavy grazing. I of course do not include the plantations amongst the Reserves. The exception alluded to is the Allur Reserve which has been closed because part of it has been opened up as a sandal plantation. The unplanted portion has for some years been extensively, and, so far as germination goes, successfully dibbled, but although closed to cattle quite 90 per cent of the artificially raised plants have been eaten down by deer and are unlikely to mature. Now if such damage can be caused by a few deer alone, is it surprising that sandal is scarce in the other Reserves which are exposed to fire and cattle grazing as well?

A close inspection in these Reserves will nevertheless occasionally discover sandal trees, *generally in association with bamboo* clumps, as well or even better grown than any outside, so that so far as they are concerned I am of opinion that the success of artificial operations in them would only depend on the efficiency of the protection. It is however, the difficulty and almost the impossibility of providing this, and of making sure during a prolonged period against the accidental appearance of fire which may at once destroy the work of years, that forms the objection to placing a reliance upon this form of reproduction. The bulk of the Reserves in the sandal zone of Coorg are otherwise capable of producing the species, but for the reasons stated promiscuous or even careful dibbling in a general way is not in my opinion to be recommended. Instead of this, *small and carefully selected areas well fenced and fire-protected* should I think be opened up and treated as proposed under the next head.

(*c*) Trees in regular plantations. On page 403 of the October "Forester" Mr. Pigot has enunciated six propositions as so many reasons against the need for this method of propagation, but the *fact* is that they are all based on the failure of our present plantations. If these had succeeded, or rather if they had fulfilled the promise of 5 or 6 years back, nothing would have been heard of the unnecessity of plantations. It seems to me that there are two reasons for the other side of the argument which bear down all this opposition and for which we should concentrate our efforts at arriving at a successful and reasonably expensive means of establishing *the tree in plantations, or* well defined areas of artificial propagation. They are (1) the vast importance of having a complete grasp of the annual yield. All the attempts to obtain this under present conditions through the means of a general census of trees scattered over the country have resulted in absolute failure. The reliability of the census which under elaborate preparations has been going on in Mysore since 1895 was described in most unsatisfactory terms by Colonel Campbell Walker, who has called for more reliable figures. Whilst the significance of the two enumerations taken in Coorg in 1873, and 1879, if carried down to the present time, would show that the present number should be a *minus* quantity whereas the actual collection last year was almost the greatest on record. (2) The *second reason above*-mentioned is the enormous wastage (and possibly theft) which goes on under present conditions, owing to the absolute impossibility of supervising hundreds of square miles of country in order to pick the trees as they mature. Nothing less than a glance at the material now being brought to depot would realise *the waste of* quantity and quality which takes place. Many of the trunks received are mere shells. I am writing at present in

the depot and at a rough estimate it would appear that certainly 20 per cent of the heartwood is lost by rot or weathering before the wood is brought in, not to speak of good material bored and depreciated by a caterpillar which only attacks dead wood.

As stated it is all a question of the want of success of our plantations. I have during the last few months paid considerable attention to these in order to discover if possible the cause of their failure. I think it has been admitted by all who have knowledge of them that the primary cause of failure was the mistake, perhaps enforced by the necessity of working with an untrained staff, of attempting to rear the species in the open and ignoring the provision of that degree of shade which the species naturally demands. In only a few patches and apparently experimentally, was cover afforded and where these have not failed owing to the depredations of deer and suppression from the neglect to weed in time, the results are now a splendid success. Returning to the open plantations it must not be forgotten that in the year 1890 they were inspected by Mr. Hill, the Acting Inspector General of Forests, and were described as a success and as placing the future supply of sandal wood beyond a question. No general decadence was reported until 1896, but it is probable nevertheless that it was gradually going on as only 2 years later when the subject was reported on by Mr. Pigot, the plantations were described as absolute failures. Now when Mr. Hill saw the plantations the age of the trees extended up to 18 years and nothing was said about the decay of the older trees, which is the main feature of the failure in Mr. Pigot's report of 1898. Although the younger compartments share the present failure they need not be taken into consideration here, because we know that the trees can be brought up successfully beyond that stage and besides the cause of their ill-success is, I fancy, not far to seek.

As regards the older trees in which decay appeared between 1890 and 1895. When the matter was reported to the Inspector General in 1898, he replied that there must have been a change of conditions under which the trees were previously flourishing. The correctness of the surmise must I think be apparent on consideration. Here are trees, growing in a locality indigenous to the species and surrounded by hundreds and thousands of naturally propagated individuals, which have flourished beyond the age when they are most susceptible to their natural enemies; which are now completely protected from the chief of these viz. fire and cattle, and which after a period of promising growth, in spite of all, disappointingly decay and die out. It is unlikely that this has happened because the seeds have been handled by human beings, or because they are growing in rows at so many feet apart. How then can the present unsatisfactory state of things be accounted for?

With very great diffidence I venture to draw attention to two facts, not assumptions, which I think may afford us a clue to the answer. The first, is the difference in growing conditions then and now, consequent on a deliberate change of management. In 1890 the appearance of the compartments is described as clear of grass and undergrowth, and the trees as having the appearance of standing "in a well grazed orchard." Now, the ground is covered with a growth of grass and shrubs which whilst it does not afford sufficiently high or thick shade to the ground surface to cool it, blocks up the space between the stems and prevents a circulation of air currents.

The second fact is the startling difference to be now observed in the plantations between the trees standing on fire traces and the broader compartment lines and those to one side of them. Here we have side by side for purposes of present comparison, an exact reproduction on a small scale, of the old system and the new, and it proves without the shadow of a doubt that the former was the better suited of the two for the cultivation of sandal *in the open.* The trees on the lines are healthy and prospering, although of course not so developed as they would be if growing, under natural conditions of shade, but the others are decaying, and if left alone appear certain to die before reaching maturity and probably long before then. The difference commences on the edge of the lines and is maintained in localities so far apart as the Herikere, Banawara and Gangwara plantations. At first sight one would attribute it to fire, but although this was the explanation which once seemed to me most probably correct, I was afterwards obliged to drop it on being convinced that fire had never touched the portions referred to. Now Hartig lays down in his Diseases of Trees—article on Bark scorching—that a quantity of undergrowth, such apparently as that described above, actually *causes an increase of temperature at the ground surface* by excluding the circulation of the air. But although sandal suffers severely from scorching, it is not in that way that the excessive surface temperature is, I believe, most harmful in this case. For that matter the trees on the firelines show scorching as well as that others. But knowing as we do that the species although it has a tap root is for the most part a surface feeder, witness its habit of propogating itself by rootsuckers, is it not certain that the root system must be affected by this increased surface heat? Observe how the species, naturally shade bearing to a remarkable degree, shows its intolerance towards this influence even in its trunk and upper organs, how it is scorched, crown contracted and stunted by exposure and even killed outright by sudden isolation. Is it improbable the therefore that the roots the most sensitive parts of the plant should react to heat exposure even more than the stem branches and leaves? I am inclined to think tha

here we have an explanation not far from the truth for the failure of our older compartments to fulfil the promise of their former days.

No doubt other Forest Officers have had a similar experience in Indian plantations, and it would be interesting to hear of other cases in which injury or death has been ascribed to the same cause. A superheated surface soil would appear to be not an uncommon danger in Indian sylviculture, connected with the cultivation of delicate and exotic species and of others out of their climatic or other natural habit of growth. For example, in the North Arcot District of Madras, an exactly similar disaster occurred to the 3 or 4 years old Casuarina Plantations at Kilminnet and Viriujipuram, which are situated 80 miles from the coast. Here the contrast was presented to us by neighbouring private plantations, in every other way similar to ours, except that they showed continued prosperity and that the lower branches up to 5 feet or so from the ground were snapped off for fuel in a country where this was scarce and expensive, and thus way was made for the free circulation of air currents along the ground surface.

It has often been said of sandal that it requires "air at its roots" and this may be another possible explanation, but I believe the true significance of the statement is that the air means a comparatively cool ground surface and that this, provided either by a free circulation or by *high* shade, is the principal requirement of the species. By high shade is not meant forest shade but such as would suffice to protect the bole, which also appears to be an important requirement. If a broken *top* shade could be obtained which would provide these two conditions as well as prevent too complete an exposure of the crown, I believe the perfection of requirements in this respect would be realised.

Coming to remedies, it is generally accepted that the provision of a top shade as soon as possible is the essential requirement in these plantations, but if there is any truth in the views advanced in the preceeding paragraphs, a further planting up is to be avoided unless some measures are taken at the same time to admit more air to the surface. This I would do after taking precautions to protect the young shade growth by freely admitting cattle to all the older compartments, and even at the expense of some nibbling of side branches, because the removal and the keeping down of the grass by manual labour would be too expensive. In some parts a little thinning of the sandal itself would be necessary for the same purpose as the removal of the grass. In compartments where cattle would be dangerous broad lines in the direction of the prevailing wind in the hot weather would be necessary.

I have already trespassed so largely on your space that I will attempt to be as brief as possible in my remaining remarks.

As regards future plantations there are three directions in

which experiments may be started in Coorg. They are:—

(1) Planting and dibbling under bamboos. This is the best natural shade for sandal and there is a great deal of suitable bamboo jungle in the Reserves and paisaries in North Coorg. The areas taken up should be thoroughly well fenced and fire protected and the bamboo should be young. The other advantages of bamboo are that the top shade can be easily regulated, the soil at the clumps by the side of which the sandal should be put down is generally raised, aerated and well drained; bamboo keeps down other tall grasses and so diminishes the risk from fire and lastly the clump is generally surrounded by a ring of thorny, leafless side branches, which project 3 or 4 feet from the sides of the clump and within the shelter of which the species is safe from deer or cattle. It is significant that most of the sandal which survives in the Reserved forests and forested wastes has sprung up under the protection of bamboo.

(2) Planting and dibbling in similarly fenced and protected areas selected from the ordinary forests in the Reserves and adjoining wastes. A broken forest growth is preferable, such as is more frequently found on the outskirts of areas adjoining grazing grounds and cultivation. Within the selected area the forest growth will be left in groups and underplanted. It has been found that when a uniform top cover is left and the undergrowth cleared for planting, the regrowth is difficult to manage and threatens the sandal with suppression and risk of fire. The group system allows the necessary side light and the undergrowth in the groups can be regulated, whereas that which springs up in the cleared spaces can be kept down by admitting cattle, under precautions as regards the sandal under the trees. Anogeissus latifolia, Dalbergia latifolia, the fig family and of course bamboos, appear to be the most suitable as shade trees of the forest growth in these parts.

(3) The underplanting of Casuarina. At present we have no plantations of this species, but as there is suitable ground for it on the banks of the Cauvery and Mr. Pigot speaks so well of the Mysore experiments, it is worth trial. In North Arcot where there is a little sandal a large number of young sandal came up in a Casuarina plantation on the Palmaner plateau from seed dropped by birds, and the rest of the plantation was artificially underplanted with success.

The last of the 4 classes of lands for the supply of sandalwood is (*d*) waste lands. This is at present by far the most important source of supply in Coorg. Besides its general liability to grazing and fires and the encroachments of cultivation, all of which tend to reduce the natural stock on it, this supply is threatend by a most serious danger which Mr. Pigot has called the Lantana invasion. The process of suppression and burning to which Lantana subjects sandal has been described by previous Deputy Conservators in charge of the Province.

Shortly, it has been generally accepted that Lantana is the death of sandal. It remains to report the range and progress of this weed.

As it flourishes equally well at all elevations which obtain in the sandal bearing part of Coorg, witness Fraserpett and Mercara, there seems to be nothing to prevent its gradually covering the whole area, and no manner of exterminating or checking it on a large scale is known, which would not be prohibitively expensive. I believe it is not more than 20 years since Lantana first made its presence felt as a burden. So far it has established itself over the South eastern portion of the sandal area, and it has ruined whatever chances of success belonged to all the plantations to the South of Fraserpett, and the Bakka and parts of the Hurlikal and Herikere plantations to the north of it. I am unable to state the exact rate of progress, but of the fact that it is spreading there is no doubt and the danger to sandal is therefore a very real, even if a slow one.

In the past hundreds of rupees have been spent in dibbling on these lands. It is not to be supposed that Rangers and Foresters have not been instructed again and again in the proper manner of carrying out the operation, but so far it has been an admitted failure, and as much on account of the unreliability of the subordinate staff to which the work has necessarily to be entrusted as for any other reason. For instance, last season a forest Guard and Forester pointed with pride to some dibblings under thorny patches from 6 inches to 2 feet in height by the side of a track traversed daily by dozens of cattle. If the worst comes to the worst and our attempts at artificial reproduction in plantations continue to fail, I suppose the dibbling of this area under special supervision and confined to localities like roadsides which can be efficiently checked and protected will have to be undertaken, but until then, I think it would be wasteful to fritter away our limited resources on work which is so difficult of supervision and which even if successful is exposed to such uncontrollable dangers.

In conclusion I think our main efforts in the future should be directed towards improving the existing, and establishing a reliable method of raising future plantations, in preference to all other methods of reproduction hitherto suggested. At the same time attention should not be relaxed towards encouraging ryots to foster and protect the species on their lands. What success has been attained so for has been in the direction of plantations ; I allude to the Casuarina cum Sandal combination and include under the term artificial regeneration in restricted and thoroughly protected areas, such as the Devarayadurga State Forest quoted by Mr. Pigot. All the rest is theory and assumption.

C. M'CARTHY,

31st December 1899.

Natural Coppice.

With singular pleasure I have read Mr. Hearle's paper "One of Nature's coppices. Ever since I began my work in Pegu in 1856, the subject has greatly interested me, and some day I may perhaps be able to put together all I have recorded regarding it in my diaries and in my official reports. I well remember my astonishment, when walking through the burnt Kain taw of Burma, and some years later through the burnt savannahs at the foot of the Himalaya, I came across the large pink blooms of *Careya herbacea* and the scarlet flower branches of *Erythrina resupinata*, coming out of the ground, black with charcoal, among the burnt stubble of gigantic grasses.

My sole object today is, to induce those who have a garden of their own, or have charge of a forest garden or a permanent nursery in the plains to cultivate these interesting undershrubs, of which Mr. Hearle has given a list. While in India I had a garden in the plains, only during my 7 first years at Rangoon, and at that time Bamboos and Plantains interested me more. The different kinds of Bamboo I grew, in order to know them, and of the Plantains I had 18 kinds in my garden, in order to eat and to enjoy them. When in the Attaran forests in the rains of 1858, I found that the Karens had some exquisite kinds, which in those days I thought equal to the best pears and apples I had plucked and eaten in my father's garden on the banks of the Rhine. Of these plantains I brought away plants and grew them, as well as other kinds which I had got from the Karens elsewhere.

After I left India, when the Forest School had been firmly established at Dehra Dun, I tried to induce my friends, who had successively charge of that institution, to cultivate these undershrubs, which Mr. Hearle appropriately calls *Nature's coppices*, and now, encouraged by his paper, I venture to make a public appeal in behalf of these most interesting plants. Possibly these lines may catch the eye of the lords and masters of those splendid Botanic Gardens at Saharanpur and Calcutta, and may induce them to grow these humble undershrubs.

Hearle asks, whether these undershrubs have not been gradually evolved from allied tree species, which the annual jungle fires have prevented from maintaining themselves in their original form. The heading, under which many years ago I recorded my notes regarding these species, was; *Trees reduced to undershrubs* and this expresses the same idea. Each of these undershrubs however is distinguished by very definite characters in foliage, in flowers and fruit, from all allied arborescent species.

On the other hand the Sâl coppice shoots of Pilibhit and Topla, with which Hearle commences his paper, are all *Shorea robusta*, they retain the distinctive characters of that species, just

as the Spruce, which has been kept down by cattle or game, and is thereby reduced to a low shrub, always remains *Picea excelsa.* The Beech, at the limit of arborescent vegetation on the island of Corsica, is a low shrub, and far north in Norway, you find extensive areas of low undershrub, consisting of Spruce and Birch. If *Careya arborea* and *Erythrina suberosa* were, by the continuous action of the jungle fires, reduced to coppice woods, they would retain their specific characters, in the same way as Sâl retains its, or the two european Oaks, *Quercus sessiliflora* and *Quercus pedunculata,* retain theirs in the Oak coppice woods of France and Germany.

Neverthless it would be most interesting to ascertain, what effect immunity from fire would have upon these Indian undershrubs. Under the régime of the annual fires the substances elaborated by the action of roots and leaves go to increase the bulk of the underground stems or rootstalks, just as is the case with Sâl coppice or with Teak in the unprotected forest. If the shoots however are allowed to grow, what will the result be, will they be trees or shrubs, or will the shoots have a naturally short duration, like those of the Raspberry and Bramble?

While in India, I used often to draw the attention of my younger friends to these undershrubs, and suggested, that in areas, which had been protected against fire for a length of time, they should look out for them and see what had become of them under the altered conditions. Some day I hope the pages of the "Indian Forester" will give us a glowing description of magnificent plants, covered with large pink flowers and bushes of scarlet blossoms, of what under the régime of annual fires we knew as *Careya herbacea* and *Erythrina resupinata.*

Bonn, November 1899. D. BRANDIS.

The Forests of Cochin China.

An article on this subject by M. Bonde, Chief of the Forest Department in that dependency, is to be found in a recent number of the Revue des Eaux et Forêts, and may be interesting to us in India. From that article the following information is extracted.

The forests of Cochin China occupy about one sixth of the whole area of the country, or about $2\frac{1}{2}$ million acres, not including the islands of the gulf of Siam, which have another 250,000 acres. There are other 3,000,000 acres comprised in the "Sea of Bamboos" and ancient clearings, but no account is taken of these as they contain no tree vegetation.

Generally speaking, the forests are found in the east and northeast. In the west, with the exception of the island of Chaudoc or "Seven Mountains," there are only forests of *tram* Melaleuca cajeputi, "*palétuviers*" (translation unknown) and in-

ferior species. Where the forests are found the soil is undulating or hilly. The Sea of Bamboos is in the south, and the real forest lies between this and the independent tribes of Moïs to the north, and Cambogia. The soil is mostly alluvial, but in the hilly parts there are clays, sandstones, schists, and a rock called Bienhoa, a clayey peroxide of iron (is this anything like our laterites?). Lower Cochin China is cut up by numerous canals and tributaries of the Mekong and Donai which are used for transporting the timber. Since the conquest of the country all the banks of these rivers have been cleared, and the Agent of the Messageries Maritimes has already drawn attention to the coming time when large steamers will no longer be able to reach *Saigon.*

The forests contain many fine species, but utilisable individuals are scarce, for even at the time of the conquest the forests were exhausted. Since then they have been still more persecuted, so that certain species, Dalbergia latifolia, melanorrhae usitata, Dalbergia cultrata, Hopea, instead of being found a few miles from the main roads no longer exist within 50 miles of them. Only junglewoods are *left*, which *look* nice enough, but are not saleable. The species are very numerous and of the total some fifty are worthy of special attention and preservation. It has been proposed to reduce this number to half a dozen or so but even in France such a change would require a century, and in Cochin the forests, if their present mismanagement by the *civil authorities* continues, will have disappeared long first. The deciduous species are found more especially in the plains, the hilly part, contain a mixture of both deciduous and evergreen trees.

The following list of valuable species with their Annamite names may be of interest.

Dalbergia nigra. ...	trac.	Palindea sp. ...	go.
,, sp. ...	cam-lai.	Mesua ferrea. ...	vap.
Epicharis dyxoxylum.	huynh duong.	Jonquieria fraxinifolia.	cam xe.
Pterocarpus sp. ...	dang huong	Diospyros siamensis. ...	cam thi.
? ...	nan huong.	,, ebenum. ...	mung or mi-tong.
Melanorrhea sp. ...	son.	Hopea berrienii. ...	sao.
Santalum album. ...	bach duong.	,, sp. ...	sang dao,
Nauclea sp. ...	trai.	,, ,, or Carallia baradeia.	sang ma.
Mangifera sp. ...	xoay.	Vatica sp. ...	lau tau..
Vitex laxiflora. ...	binhlinh. sen.	? ...	cam lien,
Shorea sp. ...	sen.	Barixylon sp. ...	lim]
Nauclea orientalis. ...	guo.	? ...	da da.
? ...	thong tre.	Bassia Baessia. .	cho.
Shorea sp. ...	ca chae.	? ...	huynh.
Dipterocarpus sp. ...	dau.	Lagerstroemia sp. ...	bang lang.
Anisoptera sepulchrorum. ...	ven ven.	? ...	du.
Melia dubia. ...	san.	Terminalia sp. ...	chien lieu.
Calophyllum sp. ...	cong.		

Cyanodaphne sp. ...	ca duoi.	? ...	tram lauh.
Rhizophora conjugata or ,, mucronata.	viet.	? ...	tram tung.
? ...	tho dia.	Tetranthera sp. ...	boi loi.
? ...	su.	Melaleuca cajeputi. ..	tram.
Carallia lucida. or C. brachiata.	sang man	? ...	sang trang.
? ...	tram.	Shorea rubiflora. ..	chai.
Sorbus sp. ...	dang de.	? ...	loi.
...	sang den.	Garcia sp. ...	rai.
...	sang cha.	Careya sp ...	vung
Phillyrea indica. ...	ram.	Pygeum sp. ...	cam.
...	uoi.	Amooramo ntana. ...	goi.
		Pterospermum acerifolium. ...	long mang.

Before the conquest, certain valuable species, *go trac*, and *sao* were royal trees, only cut for state purposes but it does not follow, as M. Bonde seems to think, that this reservation was made with a view to the preservation of the species.

After the conquest, the newcomers called for applications to fell, the place, the species and the name and address of the applicant being required. The principal towns of the east were then indicated as places where wood markets might be held.

Clearings became so numerous that the necessity for a forest regulation became urgent, and the decree of 14th Septr. 1875 was promulgated. This decree was far from being a success so far as disforestment was concerned. It failed through the establishment of a *permis de coupe*. The commission of enquiry which preceded the decree had intended to create a class of reponsible dealers, and sought this end among other things by exacting a payment of 140 francs, but it also created a profitable monopoly for the fortunate individuals who might be able to get a hold on all the timber to the detriment even of the administration itself. It also unwittingly lent itself to a system by which Chinese or Annamite concessionaires, holding permits, but not dealing in timber, were able to sublet their contracts to men of straw living from hand to mouth over whom there was no adequate control.

The decree of 1875 had the one great advantage from the revenue officers point of view, of ensuring a considerable revenue but it took no heed of sylvicultural requirements. It said nothing about the mode of exploitation, which could only be properly controlled by the trained forest service, and the Annam revenue officers, like their fellows elsewhere, are not too fond of a trained forest service. Consequently the sub-contractors go where they like, cut what they like and commit frightful havoc. Neither is there any control over the method of extraction, which takes place regardless of standing trees or young growth. In some cases the contractor drives an axle pin into each end of a log, and

drags it over all the young plants like a huge road-roller. Thus millions of seedlings are destroyed. In all the other French colonies *the regulations for felling and extracting timber* are strictly laid down and followed. Annam alone appears to possess revenue officers who do not realise their duty.

Another cause of destruction is the system of *rai*, used by the Moi tribes. It is kind of shifting culture by fire, no doubt similar to the Indian *kumri*, *Dalhi*, *Taungya*, &c., At the end of the dry season, a piece of forest is burnt, rice is scattered over the area, without any attempt at ploughing, for one season or two, and the Moi moves on elsewhere. M Bonde asks whether the Moi acts thus because of the infertility of the soil, or because he is afraid of *being disturbed*, he *being no grazier or shepherd*, but an agricultural being who might be expected to like a fixed home. It might be replied that they feel no need of a fixed home. A distaste for any steady work, and often superstition, are the factors which rule their movements. Anyone with a knowledge of their habits and ideas could keep one of these wild colonies on the move from year to year till it broke up, if he took the trouble to do so.

The forests are watched by French guards who were till lately purely fiscal officers, but a decree of 31st July 1896 reorganised the Department to some extent, though its functions are still not properly defined. As a natural consequence the forest service and the Revenue Department are more or less at loggerheads and the former finds all its efforts crippled by the inertia or opposition of the latter.

In Cochin China, the revenue officer is too much of an autocrat, and an insufficiently educated one at that. He can or will see nothing but the current rupee. Will it pay? now, at once is all his idea. How different from European countries! France herself is spending millions of francs on forest improvement. Cochin China is not allowed even to preserve that which it has. The revenue for 1898 was 141,551 francs, and the expenditure 11,937. It is not too much to say that the whole of the 40,000 odd francs profit ought by any conscientious administrator to be put back into the forests. M. Bonde specifies the great needs of the situation :

1 Regulation and supervision of fellings.

2 Doubling the forest area by including all wooded hill tracts.

3 Prohibition of the felling of *dau cong, rai, ohai, camthi, mun, son, trac, and trai.*

4 Extraction of climbers and inferior species.

5 Planting.

He has the support of all good foresters in his desires.

The treatment of Rubber with Alum in Penang.

Copy of a letter No 1799, dated the 29th September 1899, from the Inspector General of Forests, to the Assistant Superintendent, Gardens and Forest Department, Botanic Gardens, Penang.

I have the honour to say that I have read your letter of the 31st December last, to the address of the Director of the Royal Gardens, Kew, regarding the treatment of rubber during the process of extraction with alum, with much interest. During some rubber-tapping operations which were lately undertaken in Assam much inconvenience and loss of rubber was occasioned by the wet weather. It appears that the treatment adapted by you greatly facilitates the extraction of the rubber in wet weather, and that this treatment in no way affects the value of the rubber. I should feel much obliged if you would be good enough to favour me with a full account of the treatment, as I should like to to have it tried in Assam.

Copy of a letter dated 18th November 1899, from the Assistant Superintendent, Gardens and Forest Department, Botanic Gardens, Penang, to the Inspector General Forests.

I have only just returned from leave, or your letter of the 29th September would not have remained so long unanswered.

The report of the expert to whom the Kew authorities submitted the samples of rubber was that the alum treatment does not interfere with its value. You can either stir in a pinch of powdered alum or dissolve the alum first in water, I prefer the latter. You will find that by this treatment you will get out all the rubber there is without loss of time.

VI.-EXTRACTS NOTES AND QUERIES.

The Reproduction of Sal.

The following passage occurs in the Progress Report of Forest Administration in Assam for 1898-99 (para. 33)

"The subject of natural reproduction is not one that requires treatment annually in the Administration Reports; it has been dealt with in the last two reports. The following observations, made by Mr. Perrée, Deputy Conservator, Goalpara Division, who is well acquainted with the neighbouring sal forests in Bangal, is interesting:"

"The first noticeable feature in Goalpara is the rapid progress of the tree growth along the edges of the forest, externally into the savannahs. This result has been achieved by rigid protection from fire of grass as well as tree-bearing lands. The grass remaining unburnt loses its vigor and density; seedlings appear on the edge of the existing forest, and are able to establish themselves. In a few years the tree growth obtains complete hold of the soil and the forest gradually encroaches on the savannahs. It is true that the best timber trees do not always enter into this first struggle, but sal obtains an advantage in after-years owing to its slight shade-bearing capacity."

We have no personal acquaintance with Goalpara, but in similar areas (savannahs, chandas, tappars), both within and at the edge of the sal forests of the terai of the North West Provinces, the same interesting operation of nature occurs. Here however, frost plays a very important part and the extension of the sal forest into the grassy plains is a very slow process. Year after year a mass of reproduction and coppice shoots reappears above the grass at the edge of the forest only to be cut off by the winter frosts. As the Deputy Conservator Goalpara notes, the inferior species, notably *Eugenia operculata*, *Stereospermum suaveolens*, *grevvia*, *Casearia tomentosa*, *Mallotus philippeninensis*, when found precede and nurse the sal; in other parts the unmixed sal makes slower progress, but when once it has established its superiority it comes on with great rapidity forming an even crop of saplings and poles. The danger from fire is great, and the usual practice is to leave a considerable fringe of grass along the outer edge of the forest, and to burn the central portion of the savannah. The fire line can then be gradually drawn outwards from the forest as the sal reproduction extends itself.

Inversely to the above, over felling in frosty localities leads and has led in a greater or less degree, to the creation of these savannahs. To this as well as to continuous firing their origin is in many cases probably due. Occasional fires are excusable; over felling is not.

Growing walking sticks.

The "Congo canes" which are now so popular as walking sticks in France, were first designed by a Frenchman, and the manufacture of the same was at first confined wholly to France. They are made of the common overgrowth of wood that springs up from the stumps of ordinary chestnut trees soon after the trees have been felled. For a few years France did a thriving business in this new line of manufacture, the simplicity and handsome appearance of the sticks winning rapid favour both at home and abroad. After a while however the trade reached such rapidly increasing dimensions that it attracted the attention of several large Austrian business men, who forthwith began to consider the feasibility of establishing a competition in the same line, for in certain parts of Austria and Hungary, such as the provinces of Croatia and Krain, the growth of chestnut is enormous. They rented large tracts of land from the owners, agreeing to pay in return for the wood they should take away something like half a cent for every stick. Working men were easily obtained who would cut the sticks, working 10 hours a day for the nominal wage of 80 Kreutzers (about 16 pence) per day, so that the first steps in the cost of production were reduced to a minimum. The trade once started, good results were at once noticeable, and thus the industry which is today one of the most important in the monarchy was started.

The preliminary steps to be taken in the growth and manufacture of sticks are very simple. In the early spring care must be taken to ensure a good crop of sticks. Workmen are sent into the groves with nippers, and every stick that is to be cut later on must first be nipped. March is the best month for the nipping process, for in this month the shoots begin to sprout, and by the time autumn arrives they are fit to be gathered. Forestry laws here step in with restraining regulations by providing that a certain number of sticks in every grove must be left standing until they grow to a sufficient height to be used as telegraph poles. This does not take so long as one might think, however, for Austrian telegraph poles, it may be stated, resemble closely good-sized bean-sticks, the wires being strung along the sides instead of on crossbars attached to the top of the poles.

The maximum length which the sticks reach in one seasons growth—and if they are nipped in the spring the law superficially states that they must be gathered in the fall of the same year—is two metres; in thickness they vary all the way up to 40 millimetres. Sticks which do not attain full growth by autumn must also be taken and be paid for at the regular price, but these are saved from waste by being bent and pre-

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pared to serve as umbrella handles. Thus every piece of material is utilised. When the entire crop has been gathered, the sticks are stripped of twigs and thrown into a bath of boiling water, which loosens the bark and makes the work of peeling quite easy. It is interesting to look on while the workmen deftly snatch the blistering hot sticks from the steaming pool, and with bare hands draw the bark off in large pieces, as unconcernedly as any other person would handle the cane in a finished state.—*English Mechanic.*

Early flowering of Horse Chestnuts.

We hear from Chakrata that owing to the mildness of the season a number of Horse-chestnut trees planted about the station were in full flower during December last.

National Forestry.

The subject of National Forestry, which Mr. D. E. Hutchins discussed before the Society of Arts last night, has never received in this country the attention it deserves. He speaks as an expert, for not only is he Conservator of Forests at Capetown, but he has also studied the question both in this country and on the Continent. Here the area of wood-land has greatly diminished since history began. Early in the present era the great Andred's Wald, of which the Weald is a *souvenir*, extended from the Sussex coast to the North Downs. Even in the Conqueror's time the zone of woodland north of London formed a temporary impediment to his progress. Sherwood, Needwood, Wychwood, and other forests are shrunken remnants, of their former selves. A squirrel, they say, once could go from one side of Charnwood Forest to the other without touching ground; now many parts are perfectly bare. The tradition is probably an exaggeration; but there, as in numbers of places, fields have replaced woods. Where the former are more profitable the change is, no doubt, an improvement, but Mr. Hutchins maintained that in many cases the trees have made way for moorland, which at best feeds a few sheep That is true in many parts of Scotland, Wales, and even England. It may be said that grouse moors and deer forests, as they are termed on the principal of Bottom's dream, are lucrative to their owners. Mr. Hutchins, however, seems to argue that they are not as advantageous as

they might be to the State. But, putting aside this contentious question, he points to extensive districts, as in Wales, which, at present, are of hardly any value, but might, by planting and proper care, be converted into excellent woodland. There are corresponding districts in Germany—the Black Forest, for instance—where ordinary cultivation is restricted to the richer ground in the beds of the valleys, and the hills for mile after mile are covered thickly with timber. In that country, in Belgium and France, not to mention others, Forestry is in charge of a public department. In the United States, however, as in British Colonies, the reckless destruction of timber trees, till lately, has gone on without check. Mr. Hutchins urges us to follow the example of our neighbours. Trees will often flourish, provided the right kinds be planted, on soils that are useless for pasture or ploughing. The Scotch fir often grows well upon the most sandy moor, and there are varieties of pine that will flourish even on dunes. The great sandy plain of Northern Germany is studded with fine forests, which bring in a good return, and are the most profitable form of culture. If a forest is to pay it must be looked after by experts. Indeed, we recognise this principle so far as to train men for India though not for our own country—the result being that caustic remarks are sometimes made on the management of the New Forest. The first requisite, therefore, is the establishment of a British School of Forestry. The next point is that woods can be managed more economically on a large scale. Growing timber does not require the minute attention of ordinary crops; and a considerable area of woodland may be looked after by a comparatively small but properly disposed staff. The experiment has been made in other countries, with the result that State management, or some modification of it, has been found to be the most efficient and least expensive method. Moreover, trees mature slowly. As the old Latin poet said, the landlord who plants does it to the profit of a coming age. He has to sink capital to an amount that is unfairly burdensome to the present holder, especially under existing fiscal circumstances. The care of woods means a continuity of action, difficult to obtain from the various owners of an estate. Thus Mr. Hutchins presses strongly for the creation of a Forestry Department, to take in hand, plant, and ultimately crop waste lands, paying, of course, a fair rent, in some form or other, to the owner. A vote of one million pounds a year, he estimates, would pay all the "expenses of reforesting a hundred square miles of land, now nearly profitless, and, after a certain time, not only would the outlay diminish but a revenue would even be obtained. France spends on her forests, half a million a year; Germany much more; even the Cape Colony gives sixty thousand pounds. We import at the present time eighteen million pounds' worth of timber, most of which might as well be raised in our Islands. In Belgium four-fifths of what is used is homegrown.—*Standard.*

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Future Treatment of Sal Forests.

In the Indian Forester for December 1898, we have an interesting paper on the above subject. The communications of H. H. are always interesting and valuable, and I have ever since felt a desire to amplify the subject, but have not found time to produce an article for publication. I will begin by quoting from H. H.'s preamble. He says "It is now a considerable time since 'Improvement Fellings in Sal Forests were first introduced, and 'already some of the original working schemes are approaching 'the period of revision. It therefore behoves us to begin to 'consider the effect of these fellings and whether or not we can 'start to work on regular methods of treatment.

"Improvement Fellings were introduced in a sort of despair, 'and admittedly as a temporary measure; it was considered that 'the forests were too ruined, or too irregular, to satisfactorily 'allow of an immediate application of regular methods, and it was 'therefore proposed that a preliminary run through with Improve-'ment Fellings should be made to allow of the forests growing up 'a little better under protection, and in order to remove, as far as 'circumstances would admit, the old bad stuff on the ground It 'is possible Improvement Fellings have sometimes been prescribed 'for forests which might have been at once put under regular 'treatment, 'but even' with these, if the fellings have been 'cautiously made, there has probably been a gain." I must here at once plead guilty to not having seen any of the sal forests before the Improvement Fellings were introduced, and therefore speak under the disadvantage of having to guess their former condition from their present state and from the signs of old workings It may be admitted that the introduction of Improvement Fellings was not always necessary and may have been resorted, to in some cases, as a means of putting off trouble and

responsibility. I am further of opinion that they have not always been cautiously executed. So long as a Forest Officer may consider that his work is judged by his revenue and by percentage tables, always more or less fallacious, of forest fires, offences, and what not, so long will the best class of work be subordinated to the production of such statistics as will not jeopardise a given officers reputation and prospects. Hence I have seen fellings which I could not in my own mind characterise as "improvement." This is merely my personal opinion, perhaps little worth, but it seems to some extent borne out by the admitted existence of "a grave danger" in the *absence of a volume check.* Now an improvement felling, like a thinning, is, or should be, a purely cultural operation hardly capable of a volume check. The sole object should be to do that which is requisite for the best interests of the forest, much here, little or nothing there, and the demand for a volume check implies a lack of confidence, either in the cultural knowledge, or in the moral fibre, of the executive officers. The difficulty quoted as existing in the "irregularity of the crop" is not necessarily a difficulty at all. If we are going to work the Selection Method, irregularity is the very thing we want. The mistake lay in not stating clearly the object to be sought in the improvement fellings, *i. e.*, in not deciding at once what treatment was to be applied when the improvement fellings came to an end. It is evident that improvement fellings with a view to selection working will have to differ widely in execution from improvement fellings made under the same name but with a view to the uniform method. I have seen fine sound sal marked by Rangers simply *because* there were seedlings beneath them; and for revenue. That is not my idea of "improvement." I have also seen rotten old trees standing in strong grass marked simply because they were rotten. That is certainly not improvement, for the interest of the crop required that they should be kept afoot till they fell to pieces. The result of such work is firstly blanks, secondly fires and frost. The remedy is to be found in better teaching and supervision of the Ranger by the Divisional Officer.

I do not however write for the purpose of disparagement, but rather to add my mite towards the enlargement of our views. H. H. notes the possibility of working sal under more methods than one. He rightly admits that sal coppice, especially with standards, may be desirable. He rightly admits with reservations the suitability of selection, but he pins his faith principally to the Group method, approaching the uniform method as closely as possible. I am not going to controvert this, for my knowledge of the Group system is but small. My main object is to point out that none of us possess adequate knowledge of any system or method as applied to sal though the current improvement fellings have enabled us to form some idea of the behaviour of sal, when treated in a manner more approximating to selection than to

anything else. That being the case, my great desire is to see us bind ourselves to *no general treatment*, but to *give them all a trial*, and so acquire a sound knowledge of how sal ought to be treated. There must be some one or more methods pre-eminently suited to sal, perhaps different in different districts. The only way we can acquire knowledge is by trial. I would therefore beg those who have any influence not to countenance the wholesale treatment of our forests under any one general system, and I urge the desirability of giving several systems a fair trial in various localities. The following at least might be tried.

Coppice with standards, rotations of 20 and 30 years, standards being allotted one fourth and one half of the growing space, *i. e.*, at least four forests in one locality.

Selection Method.—Exploitable age as may be thought best, but the number of blocks, and therefore the intensity of the fellings, being varied. I hardly think sufficient importance is attached to the length of the felling cycle, for a short felling cycle really means a close seed felling, and a long felling cycle means an open seed felling.

Group Method.—As advised by H. H.

Uniform Method.—At various exploitable ages, and with a varied number of secondary regeneration fellings (after-fellings).

Storeyed Forest, last but not least. There is a general disinclination to tackle this, which I think can but come of diffidence borne of inexperience, for the method is not common. Yet I am strongly disposed to think that sal would grow admirably as forest in storeys. I have even gone so far as to collect measurements of the cover of sal trees in the hope of one day seeing a sal forest in storeys created. My measurements are too few, but the set now referred to includes from 1 to 15 separate trees in every inch of girth from 10 to 58 inches and a few large trees. Hence it may be expected to give a sufficiently just preliminary idea of the amount of growing space to be allotted to each size-class. The forest in which the measurements were taken is one that has grown up fairly dense or quite dense in the portions where measurements were taken. So that the cover-areas may be taken to be those natural to sal in its unthinned state. I have also a few measurements of isolated trees to show the results of riotous living and unbridled indulgence. There is at present a tendency in some quarters to indulge young trees with too much space. As the result will be size at the expense of shape and quality, I cannot consider it a step in the right direction. Cutting comes only too natural when there is revenue to be made, restraint is the virtue which needs inculcating. Not that I am an enemy to improvement fellings or thinnings when properly carried out without a revenue bias, but it is possible to make "improvement fellings" in such a manner that there will be nothing to cut for the next fifty years or more when a permanent plan is brought in.

My measurements give the following results.

COVER.—TABLE I.—2-inch diameter classes.

Girth classes.				Average growing space	
9	to	12	inches.	37	sq feet.
13	to	18	do.	81	do.
19	to	24	do.	127	do.
25	to	30	do.	218	do.
31	to	36	do.	300	do.
37	to	42	do.	424	do.
43	to	48	do.	541	do.
49	to	54	do.	706	do.
55	to	60	do.	800	do.
61	to	66	do.	1,000	do.
67	to	72	do.	1,310	do.

COVER.—TABLE II.—4-inch diameter classes.

Girth classes.				Average growing space.	
9	to	12	inches.	37	sq. feet.
13	to	24	do.	104	do.
25	to	36	do.	259	do.
37	to	48	do.	483	do.
49	to	60	do.	732	do.
61	to	72	do.	1160	do.

COVER.—TABLE III. 6-inches diameter classes.

Girth classes.				Average growing space.	
9	to	18	inches.	66	sq. feet.
19	to	36	do.	215	do.
37	to	54	do.	558	do.
55	to	72	do.	1005	do.

My large trees are too few in number, and are down for more ground than they really cover or should be allowed. Old sal crowns are seldom circular, but scraggy in shape, and by no means fill up the area indicated by their crossed diameters 1000, sq. ft. ought to suffice for any sal in the 2 feet diameter class, though I have a stem of 74 inch covering 1662 sq. feet, one of 72 inch covering 1386 sq. feet, one of 67 inch covering 1698 sq. feet and one of 82 inch covering 1521 sq. feet.

Six-inch diameter classes are mostly in use in India, but they are a coarse unit of measurement. A 4-inch class is but little more trouble, gives results of greater exactitude in 2,3rds

the time, and has other special advantages in the present case, *viz.*, it allows the fellings to be made closer, a point of importance in treating sal.

To begin with however, an example with 6 inch classes may be given. Let the exploitable age be 120 years and let 30 years be required for a tree of one class to reach the next higher class. The exploitable tree is 2 feet diameter or 6 feet girth. There will be 30 compartments, felled one after the other in regular succession, and the stock in these compartments will at any time be as follows :—

TABLE IV.—STOCK.

Compartment cut in.	Present age of Classes, each occupying say one fourth area of coupe.			
	Class I.	Class II.	Class III.	Class IV.
	Aged.	Aged.	Aged.	Aged.
This year	120	90	60	30
Next year	119	89	59	29
2 years hence	118	88	58	28
3 „ „	117	87	57	27
4 „ „	116	86	56	26
&c.	&c.	&c.	&c.	&c.
29 years hence	91	61	31	1
30 „ „	90	60	30	0

It may be observed that in the 30th year the class aged 90 years passes from Class II into Class, I, the trees aged 60 years pass from Class III, into class II, and the trees aged 120 years pass from class I to class IV aged 0, as they are cut and their place taken by young seedlings. There is a resemblance to the selection method here, only in the latter there are at the time of felling theoretically 120 age classes, and practically about a dozen, in a crop cut at 120 years, while in storeys there there are in the present case only four age classes.

Having fixed the exploitable age at 120 years, and the felling cycle at 30 years (= 4 age classes), the next task is to decide what proportion of the coupe area to allot to each class, and to fix the number of stems that are to represent each class. In this first example it will be best to allow equal class—areas, *i. e*, one fourth of the coupe area to each of the 4 classes. Here is an analogy with the method of coppice with standards, where the standards are perhaps allotted one fourth of the coupe-area and the coppice three-fourths. The number experimentally made of stems in each class is fixed by the measurements of cover in the forest, as shown in Table III. There are 43,560 square feet in an acre, therefore each of the four classes will have 10,890 square feet to grow on.

Hence the number of trees in each class should be :

$\frac{10890}{25} = 436$ trees of Class IV (minus 10 sq. feet of room.)

$\frac{10890}{215} = 50$ " " III (plus 140 sq. feet of room.)

$\frac{10890}{558} = 19$ " " II (" 288 " ")

$\frac{10890}{1005} = 10$ " " I (" 840 " ")

The cover of class IV has been estimated at 25 square feet because the 66 square feet given in my measurement includes no stems under 9 inch girth. There remains 1258 square feet unoccupied in all the classes. This will allow 1 tree of I Class; 1 of III Class and 1 of IV Class, and 13 square feet over. The classes will therefore be as follows.

TABLE V.—Stock.

I Class ...	11 trees ...	Covering 11055 square feet.
II " ...	19 " ...	" 10602 " "
III " ...	51 " ...	" 10965 " "
IV " ...	437 " ...	" 10938 " "
		43560 = 1 acre.

If now the calculation of rate of growth is correct, the difference in number between the trees of each class may be felled every 30 years without encroaching on the capital stock. That is to say, each of the 30 compartments may be filled once in the 30 years to the extent shown below.

TABLE VI.—Felling.

Class.	Reserved.	Felled.	Cover cleared.
I ...	0	11	11055 square feet
II ...	11	8	4464 "
III ...	19	36	6880 "
IV ...	51	386	9650 "
			30049 square feet.

During the next 30 years, classes II, III, and IV will expand and become classes I, II, and III, while class I will be replaced by a new class IV springing from seed. It will however at once strike the observer that the clearing of 30049 square feet out of 43560 is a strong measure, probably too strong for sal. In practice the 386 stems in Class IV will not all be felled, but only such of them as have no future or are too crowded. Even thus the felling is a strong one.

I have already stated that the 6 inch class is a coarse unit of measurement and that a 4 inch class has special advantages in this case.

It is easily seen that the severity of the felling is due largely to the wide interval between the classes, which necessitates the removal of 30 years increment at once. A 4 inch class-interval will lessen the disadvantage. Let the rate of growth remain the same, *i. e.*, 20 years to put on 4 inches of diameter. The cover areas will be found mostly in Table II, but the top class has been limited to 1000 square feet and the bottom class placed at 20 feet, as my measurements do not go below 9 inches girth. There will be 6 classes, the felling cycle will be 20 years, and consequently the compartments will be 20 instead of 30. The standing stock before a felling will be as follows, the mean class-area being 7260 square feet.

TABLE VII.—STOCK.

Class.	Girth.	No. of trees.	Cover of each tree.	Cover of class.
I	60 to 72 in.	7	1000	7000
II	48 to 60	10	732	7320
III	36 to 48	15	483	7245
IV	24 to 36	28	259	7252
V	12 to 24	72	104	7483
VI	0 to 12	363	20	7260

In each of the 20 compartments there will be a felling once in 20 years to the following extent.

TABLE VIII.—STOCK.

Class.	Reserved.	Felled.	Cover cleared.
I	0	7	7000 sq. feet.
II	7	3	2196 do.
III	10	5	2415 do.
IV	15	13	3367 do.
V	28	44	4576 do.
VI	72	291	5820 do.
Total	...	...	25374 sq. feet.

The clearing being only 25374 sq. feet, as against 30049 with 6-inch classes, per acre. In this case, as in the first, in practice many more than 72 stems will be reserved in class VI. Out of the 25374 sq feet cleared per acre, 7260 sq. feet, will be occupied by young seedlings and the remaining 18114 sq. feet though it may at first become clothed with unnecessary seedlings, will soon be taken up by the expansion of the crowns of the 5 other classes.

One more example, of a somewhat more difficult nature, but likely to occur in starting a Storeyed Forest, is given below. In this third example the forest to be worked in Storeys will be one of the ordinary *Indian sort, with no kind of order already existing* in its composition. Some advantage will also be sought to be gained by the adoption of the Gurnand principle. Whatever else may be wrong or disputable about the Gurnand method, its fundamental idea is decidedly good. M. Gurnand says that it is wasteful to devote a whole acre full of seedlings to the production of an acre of mature trees, since an ample number of seedlings may be obtained off say a quarter acre. If we require 30 mature trees per acre, why should we produce a thousand saplings to choose from, when a hundred or two will give an ample choice. In the uniform method *there is no alternative, since the age* classes must go by equal areas, but in Selection and Storeys it may be possible to do better and grow a smaller proportion of useless saplings and a greater proportion of the higher classes. Let the classes remain at 4-inch diameter intervals, and the rate of growth remain the same, *i. e.*, 20 years to pass from class to class. The existing stock in the forest is however found by enumeration to be as follows per acre.

TABLE IX. Original constitution.

Class.	Girth.	No. of trees.	Cover.	
I	60 to 72 inch.	2	2200	sq. feet.
II	48 to 60	6	4800	do.
III	36 to 48	24	12000	do.
IV	24 to 36	25	6560	do.
V	12 to 24	80	8000	do.
VI	0 to 12	500	10000	do.
		Total ...	43560	sq. feet.

Whereas the constitution desired is as follows per acre.

TABLE X.—Desired Constitution.

Class.	No. of trees.	Cover per tree.	Cover per class.
I	9	1000	9000
II	12	760	9120
III	18	480	8640
IV	28	260	7280
V	60	100	6000
VI	176	20	3520
		Total ...	43560

The first 20 years' fellings will therefore be as indicated below, for each of the 20 compartments in turn.

FELLINGS.—TABLE XI.—1901 to 1920.—Coupes 1—20.

Class.	Stems found.		Stems cut.		Stems cover.	
	No.	Cover.	No.	Cover.	No.	Cover.
I	2	2200	2	2200	...	...
II	6	4800	...	...	6	4800
III	24	12000	12	6000	12	6000
IV	25	6560	7	1838	18	4722
V	80	8000	52	5200	28	2800
VI	500	10000	200	4000	300	6000
		43560		19238		24322
						19238
						[illegible]

The area cleared in the first felling cycle is 19238 square feet per acre. This is probably not too much, as D'Arcy shows 30,000 odd square feet cleared per acre. Nevertheless I should be very sorry to see a sal forest cut on that liberal scale. In the next felling cycle the stock will be normal, except the lowest class, in which we have retained 300 stems in place of the 176 required. This has been done in order to diminish the cleared area, and also in full knowledge of the fact that before the next felling comes round many of these 300 stems will have been crushed out by the expansion of the *higher* classes. They will not be crushed out by expansion *among themselves* because the 200 stems cut, must be so selected as to liberate sufficiently all of the remainder that have a real future before them, *i. e.*, those that stand away from the larger trees and are of promising shape and growth. Let us now see what will happen in the 19238 square feet that have been uncovered. Imprimis, the whole of it will, in a general way, be appropriated by seedlings, but the upper classes will not delay to claim the share due to them, leaving to the seedlings only the amount alloted. The absorption or re-clothing

of the cleared area by the various classes will therefore be somewhat as follows.

TABLE XII.—Absorption of cleared area.

Class.	Stems kept.		Become stems.			Absorption sq. feet.
	No.	Cover.	Class.	No.	Cover.	
I	...	...	..	...	..	.
II	6	4800	I	6	6000	1200
III	12	6000	II	12	9120	3100
IV	18	4722	III	18	8640	3918
V	28	2800	IV	28	7280	4180
VI	300	6000	V	? 60	6000	..
			VI	?300	6520	the remainder.
					[43560	19238

It is evident that in the above table the absorption is pure theory and perhaps not correct at that, but with an abnormal forest in this transition stage, it is impossible to say how much area a given class will take. The table merely gives an idea of the reasoning.

The second 20 years' fellings will therefore be about as given below.

FELLINGS.—TABLE XIII.—1921 to 1940—Coupes 1 20.

Class.	Stems found.		Stems cut.		Stems kept.	
	No.	Cover.	No.	Cover.	No.	Cover.
I	6	6000	6	6000	..	...
II	12	9120	3	2197	9	6923
III	18	8640	6	2880	12	5760
IV	28	7280	10	2600	18	4680
V	60*	6000	32	3200	28	2800
VI	176*	6520	116	4303	60	2217
	*at least.	43560		21180		22380
						21180
						[illegible]

This time the felling has extended over 21180 square feet per acre, which is more than I like, but will do to follow out the example. The absorption of the cleared area will be somewhat as follows :—

TABLE XIV.—Absorption of cleared area.

Stems kept.			Become stems.			Absorption sq. ft.
Class	No.	Cover.	Class.	No	Cover.	
I	..	...	...	...	..	..
II	9	6923	I	9	9000	2077
III	12	5760	II	12	9120	3360
IV	18	4680	III	18	8640	3960
V	28	2800	IV	28	7280	4480
VI	60	2217	V	60	6000	3783
			VI	176	3520	3510
		22380			43560	21180

It will be seen that the stock has already become practically normal in 40 years. I am inclined to think that had something like this been prescribed 15 years ago instead of a series of indefinite so-called improvement fellings, we should at least have known what we wanted and been on the road to secure it.

The third cycle of fellings will be as follows :—

FELLINGS —TABLE XV.—1941 to 1960—Coupes 1-20.

Class.	Stems found.		Stems cut.		Stems out.	
	No.	Cover.	No.	Cover.	No.	Cover.
I	9	9000	9	9000	...	...
II	12	9120	3	2197	9	6923
III	18	8640	6	2880	12	5760
IV	28	7280	10	2600	18	4680
V	60	6000	32	3200	28	2800
VI	176	3520	116	2320	60	1200
		43560		22197		21363
						22197
						43560

Q. E. F.—The stock is now normal and will remain so as long as the fellings follow Table XV, the reserves being carefully kept up to the number prescribed If this is done for the four higher classes, the two lower ones may be safely left uncounted in practice.

At a casual glance there seems to be apparently a fatal objection to the above arrangement. The question may be asked, "How can you pretend you only allow 3520 square feet to the

lowest class, when you clear away the whole of the top class covering *9000 square feet*. The point is a good one, but there is a parry which I have sought to indicate by Tables XII and XIV. It is true, as already pointed, that for the moment after a felling the whole cleared area belongs to the seedlings, but this moment is of short duration. Every year reduces the area under seedlings till it attains the prescribed dimensions. The felling in a given class is not sufficient at any rate in the present case to provide for the expansion of the remaining *trees left in that class*. Table XVI and last will it is hoped make this clear.

TABLE XVI.—Allotment of cleared areas.

Old class.	Covered sq. ft.	Becoming new class.	Requires. sq. ft.	Less.	More.
I	9000	.	..	9000	...
II	2120	I	9000	120	...
III	8640	II	9120	...	480
IV	7280	III	8640	...	1360
V	6000	IV	7280	..	1280
VI	3520	V	6000	.	2480
		VI	3520	....	3520
			I	9120	9120

The rest of each acre remains under the former tenants. For instance, referring back to Table XV it is seen that in class II, 3 *trees covering* 2197 square feet are cut, while 9 trees covering 6923 square feet are kept. But these 9 trees, the old tenants of the class-area, require 9000 square feet. They keep the 6923 square feet on which they are actually standing, they lose the greater part of the 2197 square feet on which their 3 contemporaries stood, for most of that area will be appropriated by neighbours of all classes and seedlings, and they obtain 2197 *square feet (or so much as they failed to recover of their 3* contemporaries land) out of the 9000 square feet cleared in the 1st class. The other classes do likewise. The apparent paradox in Table XVI, (class II becoming class I on a smaller area) is really no paradox at all, since the number of trees in class I is smaller.

In the above scheme, the fellings remove the stock on about half the area of the coupe, which, as already stated, is more than I like for sal, but on the other hand if the fellings are light the cost of extraction will be greater, and for the present the subject has been treated at perhaps wearisome length. Criticisms, friendly or otherwise, are invited, I do not pose as a master but as a student, and if my ignorance is exposed, so much the better for us all. *And now to other considerations. The very first*

objection that will be made will probably be to the effect that the method is complicated, and cannot be worked without a properly trained staff. The method is in my opinion no more complicated than some of the workings going on now, and is not likely to be less satisfactory in its results.

I can think of no other weighty objections to the method of storeys being tried; but shall be pleased to hear those which may occur to others. There may be fatal ones that have escaped my notice. The questions of closure and of grazing do not appear to require special discussion, as they present no points of essential difference from the same matters under selection.

In the case of sal coppice with standards I am aware that such forests already exist in a few places; worked on rotations of perhaps 15 to 25 years, but those I have seen are either of too poor a quality or have not been established long enough. The Marha coppice in Kheri has about 50 to 60 standards per acre with a rotation of 25 years. They are not very large, and appear to have an average cover of about 200 to 250 square feet per tree, according to measurements of 139 sal standards made by students of the Forest School. This works out to one third of each acre covered by standards, but without any claim to precision. At present the cover does not appear to be too heavy, as the shoots still suffer to some extent from frost. But it is clear that before 25 years come round the cover will be considerably more and may perhaps affect the growth of the coppice. If so, there will be a difficulty, for standard fellings in a half grown coppice crop are not a thing to be hastily welcomed.

Another method that might be tried, and would probably suit sal, is coppice selection (furetage). Cutting out one or two of the biggest shoots in each clump every ten years, more or less, would yield a lot of small building material and fuel without letting in much danger of fire and would be a good thing for the soil too. What drawbacks or difficulties there would be remains to be seen. The only obvious one is the diffusion of the working, or lack of intensity in the fellings. The method is so easy that anyone could carry it out. The supervision of contractors would be equally easy if the possibility were by number of shoots per clump. If the possibility were fixed by size, say cutting all shoots over 4 inches diameter, contractors would doubtless succeed in cutting undersized stems and getting them into the fuel stacks. The sylviculture is not easy to foresee. It might be found that in such a forest, sal would habitually send up only two shoots per stool capable of surviving. Experiment is desireable.

The rate of growth of sal naturally varies with the locality and treatment. For purposes of Selection or Storeys there are sample plots available, but in most cases they are small and the

records cover an insufficient series of years. The rate obtained from these sample plots varies from 0 up to as much as 2 inches of girth per year, according as the stem is a suppressed or a dominant one. It will not do to take the mean of all the stems in the plot, for those that are doomed to suppression are but accessory to the growth of the dominant ones. It is these latter which dictate the number of years required to pass from one class to the next. Consequently the rate of growth should be obtained from the mean of the dominant stems only. In Kheri, they have taken 0.6 inch of girth per year, being the mean of thinned and unthinned plots. I should have expected more. In Dehra Dun, coppice shoots, unthinned, gave a rate of 0·8 inch per year for the 10 or 15 years since Greigs thinnings were made, but these were only casual measurements not worthy of much confidence. The proper determination of the rate of growth must be carefully carried out in each locality.

The effect of the rate of growth, fast or slow, on the storeyed forest treatment offers scope for a complete study in itself, but this article has already reached a great length, and before proceeding further I had better wait and see how far my bones are to be scattered over the pages of the "Indian Forester" for what I have already written. I hope others will summon up interest enough to let us have their ideas, whether they run my trail or a new one of their own.

F. GLEADOW.

III.—OFFICIAL PAPERS & INTELLIGENCE.

Kendir Fibre.

With reference to the extract on the subject of a 'new Textile Plant" on page 453 of *The Indian Forester* vol. XXV. November 1899), Sir William Thiselton-Dyer desires me to draw your attention to an article in the *Kew Bulletin* (1898, p. 18,) under the heading Kendir Fibre."

I enclose herewith the number containing this article.

S. T. DUNN.

Royal Gardens, Kew.
1st January, 1900.

Extract from Royal Gardens, Kew, Bulletin of Miscellaneous Information No. 140 of August, 1898, *re Kendir Fibre, Apocynum venetum, Linn.*

In November, 1896, a letter was received from the Foreign office, forwarding a copy of a Report on the Nijni-Novgorod Exhibition of 1896, containing a reference to a fibre plant successfully used in the manufactures of Russian paper money. With the report a packet of the seed of the plant was received.

The following particulars were furnished (*Foreign Office Reports* 1896 *Miscellaneous*, Series, No. 409, pp. 16-17) :—

"Attention was especially drawn to a plant (*Apocynum sibericum*) which grows within the Semiraychinsky district, near the River Amu Daria and the Ili. The local name is "Kendir" or "Turka," and it is much employed by the natives, who use the fibre for their ropes and fishing nets. Its chief properties seem to be the very great strength of the fibre, and the fact that it grows without irrigation. Specimens have been shown at various Russian Exhibitions, but the Government only took serious steps to procure any large quantities in 1894, and in the following year it was used successfully in the manufacture of Russian paper money.

"With the seed brought back in 1894, sowings were made in various parts of Russia, and these gave good results at Poltava, where the plants grew to a height of four feet in two years. In a wild state it reaches a height of six feet, growing best when on a hill-side near a river, sufficiently low to benefit by the spring floods. I enclose a small sample of seed, and some flax from the autumn crop; that gathered in the spring is of a lighter shade."

The seed sown at Kew germinated this summer and yielded four plants. From these it was possible to identify the species as *Apocynum venetum*, L., of which A. sibiricum is a synonym. (See *Journal Linnean Society*, xxvi., p. 98.)

In the *Flora of British India*, iii., p. 657, *Apocynum venetum*, L., is described as an undershrub with slender cylindrical stems and branches. Leaves 2–3 ins. long by ⅛–⅜ in. broad, linear oblong or oblong lanceolate, entire or crenulate; nerves very slender; petiole very short. Flowers in small, erect, subcorymbose cymes; bracts subulate, ⅓ in. diam., purplish, puberulous. Fruit consisting of two long, slender follicles. The plant is distributed from Southern Europe to Asia Minor, through Siberia and Northern India to Mandshuria and Japan.

The following account, with a plate, is given by Dr. J. E. T. Aitchison, C.I.E., in the *Transactions of the Linnean Society*, 2nd Ser. Bot. iii., p. 87, t. 37, on the Botany of the Afghan Delimitation Commission of 1884–85:—

Apocynum venetum, *Linn.*; *Boiss. Fl. Or.* iv. p. 48 (plate xxxvii.).

Badghis: 115, March 5, 1885. Native names: Dumb-i-roba, Kundar, Dumb-i-gosala. Common in beds of streams and in marshy localities at Gulran, at an altitude of 2,000 feet. Stems about 4 ft. high, springing from a creeping rootstock, and terminating in a panicle of flowers. The annual stems remain attached to the rootstocks, but by the action of the wind they are soon reduced to their fibrous element, and this is found in bunches, having the appearance of artificial preparation. My attention was attracted to them by the seed-vessels still persistent on the battered branches. The fibre is a most excellent one, and the wonder is, as the plant seems to be common from Eastern Europe to China, that it has not heretofore been employed in manufactures. The bark of the creeping rootstocks is employed in tanning the leather skins used as water bottles.

Roots of this plant were sent to Saharunpore, whence we received flowering specimens for the Herbarium at Kew.

A more detailed account of the plant had previously been received from Dr. Aitchison.

Dr. J. E. T. Aitchison to Royal Gardens, Kew.

Gulran, 8th March, 1883.

Dear Sir Joseph Hooker,

Since I wrote last to you only a couple of days ago, I have come across a find—an Asclepiad, a fibre plant that grows in marshy land, amongst loam with sweet water, about five feet high, annual shoots from a woody rootstock, and great creeping thick roots,

I first of all noticed the shrub-like plant in good seed, and the seed flying about out of a pair of very long pods that belong to the Apocynaceæ, the seeds with silky plumes. On examining the stems, bundles of several years' collected together, the bases were covered with a mass of what looked like tow (naturally exfoliated from the standing stems by rubbing against each other during a wind), very silky, and a good fibre. This natural tow, with the fruit and seeds, I have sent you by sample post. The natives of the surrounding parts, especially the Turkomans, say that ordinary twine and rope is made from the fibre, but that a tribe of Turkomans, called Kayák, east of Bokhara, who live at a place called Kaná, manufacture cloth from this fibre. The natives here call that cloth Katán. The plant is called Dúmb-e-robá (tail of fox), or Dumb-e-Gosallá (tail of calf), this name, no doubt, due to the fluffy seed.

The bark of the rootstock is employed for tanning, or rather preparing, skins to hold water, and it is known as "Gao-gosh" (cow's ear). These skins become red in preparation and waterproof.

A Russian traveller, Prejevalsky, mentions a cloth being made at Lobnor, in his travels, from an Asclepiad.

As I think it is likely to turn out a good thing, I have sent to Saharunpore a large number of the roots, which were just showing eyes like potatoes, and hope they may succeed. I have no doubt, if you have Prejevalsky's species, that you will be able to recognize my plant from the fruit. This is nearly 5 ins. long, and not thicker than $\frac{1}{4}$ in. With the seeds, you will be able to raise some plants. The roots during winter are covered with water, and in summer I should say are almost dry. It is in immense quantities in this vicinity, only in marshy ground. The natives call the cloth Katán, but this is the Persian name for linen and hemp fabrics indiscriminately. We would require to get the true Turki [illegible].

Forsyth, in his Yarkand report, mentions a cloth called "*Laf.*" I feel sure this is the same. Native information said it was produced from a plant that had a fruit like the Liquorice.

The annual shoots, growing in March and coming to perfection during the summer, would lead one to suppose it might do well in India. The fibre I have sent you is merely what I collected on the stalks, but, of course, if collected at the proper season, it would be of much better quality—as it is, it is very good.

I am, &c.,

(Sd). J. E. T. AITCHISON.

VI.—EXTRACTS NOTES AND QUERIES

Changamanga—Relative growth of young sissoo and mulberry shoots.—Water.

About this time last year were published some measurements made at Changamanga by students of the Imperial Forest School. Those measurement tended to show that sissoo was the faster growing species for the first 2 or 3 years, being overtaken by mulberry in the 4th year. The Divisional Officer was not content with this result, but maintained that mulberry was always the faster growing, and made an extensive series of measurements to prove it. The students this year have measured the dominant shoots of every clump along the trenches over a considerable part of compartment 3 and found as follows :—

Species.	No of stems measured	Mean height.
Sissoo ...	466	9 feet 2 inches.
Mulberry ...	599	9 feet 10 inches.

The species are mixed, and 2 years old.

These figures show that the Divisional Officer was right. The error must have arisen through students measuring mulberry shoots in clumps lying away from the trenches and consequently with no likely future. At the same time it would doubtless be an easy matter, by carefully reducing the irrigation, to arrange that the sissoo should from the beginning take and maintain the lead. The trouble of root-rot, with its consequent wind falls would also be diminished at the same time. But the rate of growth and soil production are so bound up with the irrigation that this method of maintaining the supremacy of sissoo might involve a too severe financial sacrifice. It is certainly possible, for it has been inadvertently done, to start sissoo and mulberry together, and suppress the latter by want of water while the former is, at any rate now, flourishing. It would be interesting, and possibly useful, to know the exact number of inches of water to be given annually in order to obtain this result. To prevent the suppression of sissoo by mulberry, cutting back the latter is the remedy at present adopted. Probably in the end this method will be cheaper than that of reducing the water supply and consequently the general rate of growth. Yet the latter is worth experimenting on so far as to obtain exact information.

F. GLEADOW.

The Haskin process of treating sleepers.

We have previously referred to the discussion which has been taking place between various Government and Railway Officers in India as a result of the suggestion from Mr. Francis J. E. Spring, C.I.E., Consulting Engineer for Railways, Madras, that the Haskin process of treating woods for sleepers would probably render available an enormous supply of indigenous woods at cheap rates which are not so available at present, because of their want of durability. With a view to testing the efficiency of the process, it was suggested that a sample consignment should be sent to England; but to this proposal Mr. Ribbentrop, Inspector-General of Forests, demurred that "to send specimens of timber to England to be Haskinized would not be likely to be successful, because the essence of the process is that the fresh sap of the wood should still be fully impermeated through its fibres before treatment; for it is the sap itself which, when chemically changed by heat, forms the preservative, and it would largely evaporate or change its nature during a voyage to England." Following this Mr. Spring suggested that a trial of the process might be made by converting an old rejected boiler and arranging to heat the air to be pumped into it; one end of the boiler being removeable as in the plague-disinfecting apparatus at the railway stations. "With any old Worthington pump to serve for an air pump for the purpose of the experiment" An essential of the process appears to be that air should be delivered at 400° temperature and 180 to 200 lbs. pressure. The Locomotive Superintendent of the Madras Railway would have none of it on the lines suggested, stating by way of explanation that as their old boilers were originally built to carry a working pressure of 120 lbs. and had long been considered unfit for that, therefore, even if the difficulties as to the ends and door could be got over, they would not care to run the risk of working a condemned boiler at a pressure far in excess of that it was originally intended for when new. He further went on to point out that a first-class job would be necessary at all joints with so great a pressure, and that to compress the air a pretty powerful engine would be necessary with an arrangement for circulating water round the cylinder to keep it cool; and generally that, even if possible to rig an experimental plant, it would be a considerable expense.

The suggestion then made was that difficulties should be explained to the Haskin people, and that they should be asked what they can do in the way of an experimental plant for India. (The Company's previous quotation for a plant half the size of their Millwall establishment was £12,000 f. o. b. Liverpool. This would deal with 450 standard sized sleepers per day.)

A summary of the position is given in a note by Mr. Spring, in which after reciting the correspondence on the subject, he goes on to say:—

"In that Note (21st February 1898), I argued that a saving of one rupee per sleeper would represent a saving of some Rs. 30,00,000 per annum on our Indian railways, and I suggested that the Forest Department should enquire into the merits and possibilities of the process with a view to the utilisation of great areas of forest containing trees which at present we are unable to utilize for sleeper purposes. In his Note, dated 14th April 1898, the Inspector-General of Forests, while paying a tribute to the excellence of the process, expressed a doubt whether it could possibly have the effect of saving one rupee per sleeper. In my reply, dated 17th May 1898, I tried to show how the anticipated saving might be confidently looked for, and it seems to me that my optimistic view is fully justified by the statement now received, under cover of the Government of India's No. 2098. R.S., which shows the extraordinary low prices at which, by Haskinizing the commoner sorts of pine of the Himalayas and its lower ranges, sleepers, may be obtained, to take place of the expensive deodar which at present is almost the only pine timber which it is permissible to use for sleepers.

I am strongly of opinion that by obtaining a set of Haskin's plant, and by working it judiciously amongst the forests of the cheaper sorts of timber which are now entirely unavailable for the supply of railway sleepers, the Forest Department can fend off indefinitely the invasion of this country by Australian sleepers, of doubtful *genus*, origin, and quality, which are just now being pressed on the attention of Railway Engineers at what in the absence of any knowledge of their lasting qualities look like extremely low prices.

I suppose that the enterprise of setting up a lakh worth or two of machinery is looked on as too doubtful a venture. But it is not to be compared for venturousness with the investment of money in almost any railway that might be named. I certainly think that the Madras Forest Department will be well advised to make the venture, and judging from a perusal of the above papers, I should not be surprised to hear of the Punjab Forest Department making it."—*The Indian and Eastern Engineer.*

Formalin as Preservative.

Although as a preservative medium for perishable zoological specimens, formalin has scarcely realized all the expectations entertained on its introduction, yet there can be little doubt that it has a great future before it, and that for certain purposes it is likely to prove invaluable. It has, however, many undoubted disadvantages; and in the minds of some museum officials these disadvantages appear to outweigh its manifest valuable properties, so that an unfavourable opinion is entertained of it in general. On the other hand, those who weigh more carefully

the *pros* and *cons*, realize that, under proper conditions and restrictions, its value is really very great.

As regards its disadvantages, it must be admitted that it is unsuitable for the permanent preservation of specimens that are likely to be manipulated, as not only are its effects on the hands of the worker unpleasant, but in many case it renders the tissues of the specimens themselves so hard that they are practically unworkable. Then again, it is quite unsuited for all specimens containing calcareous matter, such as molluscs, echinoderms, and crustaceans; while unsatisfactory results appear to have been obtained in the case of certain insects and myriapods. Moreover, it does not seem to be well suited for the preservation of reptiles; and it is said to deteriorate the colours of bird skins :—

Turning to its advantages as a permanent preserving fluid, it is acknowledged to be unrivalled for specimens of watery and "flabby" animals, such as jelly-fish, rendering them more coherent and less likely to disintegrate than any other known medium. Apart from this group, it does not, however, appear to be at present used to any great extent in the exhibition series in the British Museum; although we have reason to believe that its possibilities are occupying the serious attention of the officials. In the series of worms, all the more valuable specimens that were received in formalin have been transferred to spirit, and only the commoner forms left in the original medium. Of the six specimens of eggs, embryos, and larvæ of *Lepidosiren paradoxa* recently added to the series from Mr. Graham Kerr's Paraguay collection, three are in alcohol and three in formalin; the latter having been sent home in that fluid, and it being thought not advisable that the medium should be changed. If these six specimens are carefully watched, they will afford a test case of the comparative value of the media. At present, we believe, none of the exhibits in the "Index Museum" are in formalin.

For sterilising freshly killed specimens of mammals and birds as well as eggs, that have to be sent some distance to a museum in the flesh, there can be no doubt that formalin is invaluable. And it is no less valuable to the field-collector of mammals, not only on account of the small bulk a sufficiency of the fluid occupies, but also from the marvellous preservative power of the fluid itself. According to Mr. O. Thomas (who reports very favourably of it for this purpose,) commercial formalin, which is itself 40 per cent. under proof, must be diluted with no less than twenty five times its own bulk of water before use :—Moreover, whereas when mammals are preserved in spirit it is necessary to allow a very large amount of fluid to each specimen, when formalin is employed the vessel may be crammed as full as possible with specimens, which are preserved without exhibiting the slightest traces of putrefaction. When received at the British Museum all such specimens are, however, immediately transferred to alcohol on account of their unsuitablity for handling when in the original medium.

R. L. *in Nature.*

Wood Flour.

Wood flour (in German, Holzmehl) is made by grinding sawdust to a fine powder, and is used for two general purposes, *viz.*, the manufacture of explosives, especially dynamite and nitroglycerin, and (2) the manufacture of linoleum and papyrolite, or artificial flooring.

There is no manufacturer of dynamite in Berlin, but from the representative of a firm in Saxony, it has been ascertained that wood flour has been used in the manufacture of dynamite as a cheap substitute for infusorial earth, which is the standard material for that purpose. The entire German supply of infusorial earth comes from one source at Luneburg, between Hamburg and Hanover, and when that material became scarce and expensive by reason of increased demand, experiments were made with wood flour as a substitute. From the best information that can be obtained, it is regarded distinctly inferior to infusorial earth for making explosives, and is only used when extreme cheapness of product is desirable or the infusorial earth cannot be obtained.

Wood flour has also been somewhat extensively used in the manufacture of linoleum, a kind of floor cloth made by laying a coating of hardened linseed oil mixed with ground cork on a canvas net or backing; but here again it was found to be hard, inelastic, and for that reason inferior to cork meal, so that its use has been, so far as can be ascertained, abandoned by most German makers of linoleum. If used at all for this purpose, it is done secretly and would be regarded as an adulteration.

The third and by far the most important use of wood flour in Germany is for the manufacture of papyrolite or xylolite, a kind of artificial flooring, which is extensively produced by several large firms and companies in Germany, notably the Papyrolite Werke, Paul Becker, in Loebtau, near Dresden; by Hermann Jaritz & Co., of Bremen; and by Paul Karnasch, at Frankenstein, Silesia.

Papyroite is extensively used as flooring for kitchens, halls, corridors, and for public rooms, such as cafes and restaurants. It is a substance between wood and stone, practically fireproof, impervious to water, and, being a nonconductor of heat, is warm in winter. It is also used as flooring on German war vessels, because it has most of the advantages of wood, but does not splinter from shot or take fire.

Nobel's Explosives Company is about the only user of the flour in Great Britain. The secretary of that company states that he would think only about 400 tons per year would be used in connection with explosives in Scotland. That used is said to come from Montrose, near Dundee.—*Timber Trades Journal.*

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Doubtful Burmese Bamboos.

Some of my Indian friends may have heard that I have succeeded in obtaining a publisher for a work on Indian trees, for which I had long prepared myself and had collected materials. My ambition is to publish a small hand-book, which will facilitate the study of the more important trees, shrubs and bamboos of the forests in the different provinces of the British Indian Empire.

Regarding some of the most widely spread bamboos of Lower Burma I am doubtful, and I venture to submit the following remarks to the readers of the *Indian Forester*, in the hope of obtaining a few hints, and perhaps also of obtaining specimens, that may prevent my making mistakes in the treatment of this subject in my hand-book. Some of these species probably also occur in Upper Burma, and any information regarding them in that part of the country will be most acceptable. Mr. Gamble's excellent work will be quoted throughout these remarks.

A. *Single stemmed species.* For these the generic Burmese name is *Tabendain wa. I* know *8* kinds.

1. *Melocanna bambusoides*, Trinius; Gamble 118, tab. 105. The single-stemmed bamboo of the Aracan Yoma. Culms branchless to near the top, internodes 12-20 ins. culm sheaths 5-6 ins. long, blade very long. Leaves large, 6-14 ins. long and up to 3 ins. broad. Fruit fleshy, 3-5 ins. long.

2. *Wabgai*, Karen. Covers large areas in the Upper Salween forests about the headwaters of the Maytharauk stream at about 2000 feet. Culms up to 50 feet high and 10 inches in girth, completely naked and branchless in the lower part, light green, often with yellow stripes, the leaves are middle-sized, *6-8* ins. long, on the underside bluish and soft velvety to the touch. Of this I have leaves, which I collected in March 1880, and of the same species collected in February 1880, on the hills south-east of Toungoo, I have leaves and culm sheaths, (Brandis, Suggestions regarding Forest Administration, British Burma, 1886, paras.

344, 368.) The culm sheaths are short (5-5 ins.) outside with *black itching hairs, and the blade is triangular,* 3-4 ins. long. Leaves and culm sheaths are different from those of *Melocanna bambusoides*, which I collected in Assam in 1879. Mr. Gamble, who has kindly examined my specimens, thinks they resemble *Gigantochloa macrostachya*, Kurz, Gamble 63, tab. 54, which sometimes has striped stems, and which I understand forms loose tufts, but is not markedly single-stemmed. Flowers and fruit would at once settle the systematic name of *Wabgai.*

3. *Bambusa villosula*, Kurz; Gamble 56. This species Kurz had based upon my notes and upon specimens collected by me. *It is mentioned in my Attaran Report of 1860, page 50,* in the following terms:—"This species is called *Tabendein wa*, because it does not form dense clusters like the others, but the stems come up singly. It is abundant in the Attaran, and appears to occur frequently wherever there are limestone rocks near. In some places it is called *Karen wa.*" My botanical notes of March 1859 in the Upper Salween forests contain a sketch and description, of which I extract the following:—"Karen name, *Wami*, culms very tall, erect, internodes 10-16 ins. long, in their lower portion with half whorls of numerous stiff leafless branches. Leaf bearing branches at the top. *Culm sheaths very large, early* deciduous, to 20 ins. long, glabrous outside. Leaves small, 5 ins. long, glaucous beneath." Later notes state that this species is found on limestone hills in the Attaran, Salween, Thoungyeen and Yoonzaleen, not in Pegu. Of this species the flowers are unknown, and it would be important to have good specimens.

B. *Tufted, erect or spreading species.*

4. *Oxytenanthera albo-ciliata*, Munro; Gamble 70 tab. 61. *Wapyu gale* in Lower Burma. Deciduous, culms arching over and spreading, very difficult to get through, lower branches mostly single, stout, branching. Very common on *dry hills in* Tenasserim and Martaban, also in parts of Pegu. Flowers frequently, spikelets slender, curved, white ciliate ⅜ in. long. It is also called *Wagauk*, and in my Burma Report of 1881 (para. 374) it is described as follows:—"Not being tall and erect like the other species generally found with Teak, but forming dense low masses of nearly horizontal stems bending over, it is not useful in drawing up the young Teak trees, and does not therefore tend to make their stems tall and straight." My Attaran Report 1860 says (page 51), "it seems much to increase the violence of the jungle fires, the number of seedlings consequently is small, and the destruction of dry timber very considerable."

5 *Wapyugyi*. This is an erect bamboo, 20-30 feet high, peculiar to the forests east of the Sitang River, where it is common on dry hills, taking the place of *Myinwa* (*Dendrocalamus strictus*) in Pegu. It is readily known by the white longitudinal stripes on the internodes. It is tufted, but the clumps are lax, not

compact. The joints are 4 ins. in diameter, the hollow being 2½ ins. A note of mine of 28th March 1861 says:—"In the forest of this species east of Shoaygyeen, where Toungyas have been cut, I find that instead of the usual mass of herbaceous plants (Blumea, Melica) the young bamboo springs up immediately after the paddy has been harvested." Gamble identifies *Wapyugyi* with *Gigantochloa macrostachya*, Kurz, p. 63, tab. 54, which is a loosely tufted species with the internodes sometimes striped, and I am disposed to agree. Kurz, however, calls it *Wanet*, F. Fl. II, 557. According to Gamble I collected this species (in flower) in 1862. These specimens probably are at Calcutta. Information regarding its flowering, and specimens (also of culm sheaths) would be most acceptable, as well as further data regarding its geographical distribution.

C. *Scandent species. Wanwe*, the generic name in Burmese.

6. *Melocalamus compactiflorus*, Benth. and Hook; Gamble 94, tab. 84., Syn. *Pseudostachyum compactiflorum*, Kurz F. Fl. II, 567; the high level climbing bamboo. Hills east of Toungoo, 4,000-6,000 feet. Top of the Donat range in Tenasserim at 5,000 feet, "a real climber, interlacing stems and branches of the Oak and Chestnut trees" (D. B). Branches very stout, nearly as thick as the stem, internodes 14-24 ins. long, culm sheaths 6 ins. long, blade about as long, recurved, long acuminate. Leaves 6-10 ins.

7. *Teinostachyum Helferi*, Gamble 102, tab. 90, Syn. *Pseudostachyum Helferi*, Kurz F. Fl. II, 568. The low level climbing bamboo of Lower Burma up to 3,000 feet. Forms impenetrable thickets on moist mountain sides in the valleys of the Pegu Yoma, more frequently on a northerly aspect and where the heads of the strata crop out, common in the Bonee forests. Also on the hills near the Thoungyeen and generally in the Tenasserim and Martaban Provinces. Branches stout, nearly single. Internodes 3-4 feet long, 1-1½ in. diameter, greyish-green, sprinkled, especially while young, with addressed whitish bristles, culm sheaths thick, brittle, 8-10 ins. long, blade nearly as long. Leaves 6-18 ins. long.

There is another low level climbing bamboo, with *short internodes*, which is very little known.

It may perhaps be expected that I should apologise for this lengthy and detailed botanical paper. Nay, it may be argued that these remarks will not induce any Forest Officer in Burma to take an interest in bamboos. I am not going to apologise, for I am certain that in Burma at least the study of bamboos will always interest Forest Officers. I feel sure there is no Forester in Burma now who talks and writes of the "*bamboo*" in Toungya plantations, or in the Teak forest. He makes a careful distinction between Myinwa, Tinwa or Kyathounwa, for he knows that each species has its own peculiarities and its own requirements. I have

noticed that at the late Meeting of the British Association at Dover, Sir George King, one of the greatest living authorities on Indian Botany, has said that Forest Officers now-a-days, on arrival in India, are ignorant of systematic Botany, and that they are not encouraged to familiarize themselves with the species of which their forests consists.

My experience has been different. Ever since my friends in India have learnt that my hand-book, "*Indian trees*," is likely to be published, I have received so many offers of assistance, and so many instructive specimens and notes, that I feel certain I have done the right thing at present in writing a long article for the *Indian Forester* about some difficult Burmese Bamboos.

D. BRANDIS.

Bonn, January 1900.

Banana or Plaintain Flour.

On the Congo, as in most other tropical countries, the plaintain or banana is an important article of diet for both natives and Europeans. Wherever a new station or village is planted there is also planted at once the banana, so that plenty of food may be available in a short time.

The banana is very nutritious, and contains in itself nearly all the elements necessary to constitute a complete diet. It contains more than 25 per cent, of assimilable organic matters. According to Humboldt it is 48 times more nutritious than the potato. According to Crichton Campbell, the Apostle of the banana cult in America, it is 25 times more nutritious than the best wheaten bread.

The negroes sometimes use plaintain flour prepared in a primitive manner. They dry the fruits and pound them in a mortar. The flour so obtained, if kept in vessels or sacks well protected from moisture, remains good for long periods. It is very nourishing and carried by travellers especially ; a healthy and refreshing drink can even be made with it. In Central America, Columbia and Venezuela, plaintain flour is made on a large scale.

In order to make flour, the fruits are first stripped of their skins, cut into rounds and dried artificially. They are then ground and the flour sifted. The yield of flour is 20 to 25 per cent, a bunch weighing 15 lbs. gives 3 lbs. flour.

In order to ascertain the nutritive value of plaintain flour with some exactness, Dr. Thoms, Director of the Laboratory of Pharmacology at Berlin University, has submitted it to analysis. It contained 1·455 per cent, of nitrogen, equivalent to 9·01 per cent, of nitrogenous matters. Consequently, the nutritive

value of plaintain flour is considerable, and quite comparable with that of the best wheat flour, which does not contain more than 9 to 11 per cent. of nitrogenous matters. For flour, it is best to use rather unripe fruit, since the starch contents are converted into sugar as the effect of ripening. The following figures show this clearly :—

	Unripe Plaintains.	Ripe Plaintains.
Water	70·92	67·78
Starch	12·06	Trace.
Grape sugar	0·08	20·47
Cane sugar	1·34	4·50
Fat	0·21	0·58
Nitrogenous matters	3·04	4·72
Fibre	0·36	0·17
Tannin	6·53	0·34
Ash	1·04	0·95
Other matters	4·62	0·79

In Venezuela, children are largely fed on banana flour. It is also recommended for the aged, for convalescents, for nurses and for all who suffer from stomach ailments. It is sold sometimes under the name of "*Musarina.*" The following cookery recipes may be of interest :—

1. *Atol.*—A spoonful of *musarina*, a small cup of milk, a little sugar and salt. Dissolve the flour and sugar separately in a little water, mix, cook a few minutes, and add the salt.

2. *Tonic Atol.*—The same, with water instead of milk. Add a little clove, cinnamon, anise, herbs, or orange to taste.

3. *Chocolate or Cocoa.*—Mix a small spoonful of *musarina* in a cup of chocolate or cocoa. It renders it more easily digested and more nutritious, and is good for those who cannot easily take cocoa alone.

4. *Sopa salada.*—To a cup of broth add a spoonful of *musarina* dissolved in cold water. Let stand for a few minutes, adding spices if desired.

5. *Cordial.*—Whip the yolk of an egg and mix it with 30 grammes of sugar and a spoonful of *musarina* dissolved in a cup of milk. A little powdered cinnamon to taste.

6. *Pastre.*—Three eggs well beaten, 250 grammes of powdered sugar, a lemon rind, 125 grammes of *musarina* dissolved in a cup of milk. Mix, add 30 grammes of butter and bake in an oven in a buttered mould.

7. *Torta à la Sarten.*—sixty grammes of *musarina*, a whipped egg, a cup of milk, a little salt, and a small spoonful of butter. Mix and cook.

Plaintain flour may also be be used in the same manner as ordinary flour, except for bread, as it contains no gluten. Plaintain flour is delivered on the London market at £27 per ton of 2,240 pounds, but sales are small owing to the high price and

the general ignorance of its use. The day may come when Europe like America, will have its Critchton Campbell devoted to the propaganda of the plaintain as an article of food.

The above is translated from "Belgique Coloniale," and the "Revue des Cultures Coloniales" of Paris. The latter has a letter on the same subject from M. Boname, Director of the Agronomic Station of Mauritius, as follows :—

"I see you state that the trade in banana flour does not increase on account of the high price at which it is sold, one shilling a pound, when the market could only offer a third as much. I have been studying this question for some time. I do not known if my product offers the merchantable qualities desired, but if that is the case, I should be able to supply it with profit at 4 pence a pound. *This great difference is no doubt due to the* low price of bananas here,' &c., &c. Then follow two analyses from two independent sources, as follows :—

	Boname.	Petermann.
Moisture	6·50	5·60
Ash	2·35	5·93
Protein	3·87	3·13
Cellulose	1·00	1·22
Seeds	1·08	1·73
Non-nitrogenous matters ...	85 20	82·39
	100·00	100·00

For those who are not familiar with the metric system, 28 grammes may be taken as equal to 1 ounce. Some of the recipes may be worth trying.

Teak Trade in Bangkok Siam during 1898.

Teak show a considerable falling-off for the year, the annual customs returns making the figures 22,792 tons, valued at £1 9,251, as against 38,767 tons, valued at £284,012 during 1897. These figures have, however, in previous years proved somewhat unreliable and, according to data, furnished by an unofficial but probably more accurate source, the output was 26 495 tons as compared with 44,171 in 1897. In either case there is a decrease of between 15,000 tons, or roughly 40 per cent. in the annual export. This large falling-off appears to be mainly due to defective rainfall in 1897, which prevented the logs being floated out of the streams down the river, and it was predicted *in the annual report on the trade of Bangkok for 1897.* Forest preservation, which, when fully organised, will doubtless curtail the output the from the Siam forests, must not be held responsible for the present falling-off, as, owing to the long time it takes for a tree to find its way from the forest where it is felled down to Bangkok, it will be several years before the effects of this most necessary measure are felt. Sufficient proof that it cannot have yet diminished the yield is given by the fact that, whereas the logs that passed the *duty station* at Paknampoh during the floating season of 1897-1898 (the bad season above referred to) only numbered 30,800, as compared with the preceding seasons of 58,600, 64,800, and 72,200, respectively, those that have come down during the 1898-99 season amount to 76,600. This promises a big export for 1899, although it must be remembered that the number *of logs paying duty at Pak*nampoh does not of necessity stand in any fixed ratio with the export from Bangkok.

According *to the figures* privately furnished me, of the total export of 26,495 tons, 8,859 tons or 33·43 per cent. went to

Europe ; 8,498 tons or 32·08 per cent. to Bombay ; 5,871 tons or 22·16 per cent. to Hong-Kong ; and 3,267 tons or 12·33 per cent. to sundry ports.

Prices averaged about £8 f. o. b. (per ton of 50 cubic feet) for Europe timber, and about £4 for timber shipped elsewhere

The bulk of the Siam teak trade still remains in the hands of British capitalists, both in the forests and even more so in Bangkok. A large Danish company, however, has lately entered into competition, has erected a very extensive saw mill, and, as mentioned in last year's report, has started a line of steamers specially designed to carry teak.

The question of forest reform, though just now of great interest to those engaged in the Siam teak trade, more properly belongs to the report of the Consul at Chiengmai, within whose district the forests lie. Preservation is being energetically organised by British officials from Burma and India.

Timber rates in the Punjab.

The following information on the rates and prices obtained for timber in the Punjab during the year 1898-99 are taken from the Punjab Forest Administration Report.

Jhelum and Chenáb.—The average rates per cubic feet realized for different kinds of timber sold at the main sale depôts during the year under report as compared with the preceding year are given below :—

Class of Timber.	Jhelum Depot.				Wazirabad (Chenab) Depot.			
	Marked timber.		Unmarked timber		Marked timber.		Unmarked timber.	
	1897-98	1898-99	1897-98.	1898-99	1897-98.	1898-99.	1897-98	1898-99.
	R. A. P.	R. A. P.	R. A. P.	R. A. P.	R. A. P.	R. A. P.	R. A. P.	R. A. P.
Deodar logs, 1st class, per c. ft.	0 13 8·68	0 14 3·31	0 14 5·55	1 1 10·1	0 13 6	0 13 1	..	..
" " 2nd class "	0 10 3·84	0 9 6·71	0 10 11·88	0 9 5·03	0 10 3	0 9 9	0 10 1	0 6 11
" " 3rd " "	0 8 0		0 6 11·88	.	0 7 9	0 7 10	0 6 0	0 6 0
Pine logs 1st " "	0 6 9·68	0 6 10·36	0 5 2·6	0 5 0	0 7 10	0 7 5	..	.
" " 2nd " "	0 4 8·92	0 4 9·70	0 8 8·18	0 1 5·4	0 5 6	0 5 [illegible]	0 2 11	0 8 5
Deodar sleepers, 1st class, each	3 4 0	3 4 0	.		3 4 0	3 4 0	..	.
" " 2nd " "	3 14 11	.	..	..	2 15 0	2 15 0	..	..
" " 3rd " "	2 6 9	.	1 15 9	..	2 7 0	2 7 0	.	1 15 9
" " 4th " "	2 0 0	1 11 7·7	..		.	1 11 9	1 11 9	..
Deodar gattus "	.	..	..	..	2 8 1	2 10 3	1 12 0	1 14 1
" scantlings "	1 13 2	1 11 0·95	1 4 6	..	1 8 0	1 8 8	.	
" sleeper pieces "		0 14 6·2	.	.	0 12 8	0 12 10	0 9 0	0 11 11
" scraps "	..	.	..	.	0 4 6	0 5 1	0 8 4	0 4 1
Pine sleepers "	..	..	..	.	..	1 15 9	..	..
" scantlings "	1 7 2	1 6 2·4	0 13 6	0 13 6	1 3 5	.	.	F.
" scraps "	..	..	..	.	0 2 8	0 3 3	0 1 6	1 1 11

Chamba—In the Lower Ravi depôts 21,343 cubic feet of deodar logs were sold at an average rate of 10·36 annas per cubic foot, against 22,810 cubic feet at 12·32 annas in the previous year, and 4,798 cubic feet of pine and fir logs at an average rate of

3 94 annas against 4,725 cubic feet at 4·63 annas in 1897-98. The falling-off in the rate is chiefly due to the fact that almost all the very large logs lying in the river from previous fellings have been brought to depôt and sold, while all recent fellings have been exported in the shape of scantlings. The total quantity of deodar sleepers and scantlings, including pieces, sold from the Lower Rávi depôt was 238,945 cubic feet, the average selling rate being 12·29 annas per cubic feet against 161,396 at 13 13 annas in 1897-98, the reason for the falling-off in the average rate being that a large number of unserviceable sleepers and second class scantlings reached the Sháhdrah depôt. Omitting unserviceable sleepers sold to the Chief Store-keeper, North-Western Railway, 37,186 sleepers were sold to the North-Western Railway at an average rate of Rs. 3-1-7 per sleeper, the rate in 1897-98 being Rs. 3-0-4 for 34,354 sleepers. Altogether 53,771 sleepers of descriptions were sold at an average rate of Rs. 2-10-9 per sleeper, or 12·78 annas per cubic foot, which is lower than the average rate in the previous year owing to the presence of nearly 13,000 unserviceable sleepers. At the Sháhdrah depôt 18,724 cubic feet of pine and fir scantlings were sold at an average rate of 7·39 annas per cubic foot, which, although slightly better than the price realized last year is still very low. It appears that traders will pay 5 annas or 6 annas per cubic foot for pine in log because they can palm it off as deodar more easily than in scantling.

The average rates obtained for deodar and fir scantlings sold at Kálátop sale depôt were practically the same as in 1897-98. The following statement gives the details of sale :—

		Amount sold.	*Average rate, per cubic foot.*
		Cubic feet.	Annas.
1898-99, deodar scantlings	...	10,103	16 13
1897-98, Ditto.	...	9,695	16·29
1898 99, fir scantlings	...	8,484	9·85
1897-98, Ditto.	...	9,806	9 81

Kangra.—The following average rates were realised for timber sold from the Kangra depôts during the year :—

Class of Timber.	Nadaon Depot.						Wazir Bholar Depot.					
	1897-98.			1898-99.			1897 98.			1898 99.		
	Rs.	A.	P.	Rs.	A.	P.	Rs.	A.	P.	Rs.	A.	P.
Deodar logs ... Per c. foot	0	8	0	0	14·4	0	0	8·7	0	0	11·4	0
Pine logs ... ,,		...			...		0	2·7	0		...	
Blue-pine logs ,,	0	0	4·4		—			..		0	4	0
Deodar sleepers each		...			.		3·2	0	0	2·7	0	0
,, gattus ,,		...			...			...		0	12	0
,, scantlings ,,		...			...		0	13·5	0	0	11·4	0
,, sleeper pieces ,,		...			...		0	4	0	0	9·1	0
Blue-pine sleeper ,,		...			...			...		0	7	0
,, gattus ,,		...			...			...		0	6	0
,, scantlings ,,		—			—			...		9	8	0

Bashahr.—The all-round rate realised per cubic foot on deodar timber sold in log from the Doraha depot was 10·09 annas against 8·84 in 1897-98, while the figures for blue pine timber were 4·59 annas, as compared with 3·33 annas in the previous year. At Phillour the average price per cubic foot of deodar rose from 8·71 to 9·89 annas, and for blue pine from 2·67 to 3·74 annas. The average price of Bashahr broad gauge sleepers rose from Rs. 3-1-0 to Rs. 3-1-10, while the Kúlu sleepers fetched an average of Rs. 3-2-6 each.

An Elephant Hunt in the Saharanpur Siwaliks.

The Junior Classes of the Imperial Forest School were encamped at Dholkhand on January 25th. They were to march on to Beribara early next morning. But the sun of the 26th, which was somewhat late in shewing itself, having to pierce through a heavy cloak of mist, saw them mustered strong at Chillawala, 5 miles in the opposite direction. Never was an order more welcome or more heartily appreciated than the one that was circulated late in the evening of the 25th postponing the march and, permitting the students to witness the Khedda that was going to be held in the Siwaliks the next day, and the majority of them sat up the greater part of the night through sheer excitement. The Khedda party in question belonged to the Balrampur State. They had already captured one elephant in the Eastern Dun, and a large number in the hill forests of the Garhwal district, across the Ganges, and had, the previous day, moved from Beribara to Chillawla in hopes of capturing those that had been reported to have been sighted a day or two back in the hills behind that place.

The left bank of the Chillawali Rau presented to-day a scene very different from its wont. There stood, tied to the strong-rooted Zizyphus and other sturdy trees, close upon a hundred elephants of all sizes—from the gigantic Nagendar Gaj to the newly caught liliputian baby, with whom Nageshwar Parsad, another gigantic tusker, is fond of playing. In low sheds, hastily put up the previous day, lay the caretakers and their families and the beaters of the Khedda, while shouldaries were pitched on one side to accommodate a small detachment of the State Cavalry together with the Captain and his assistants, altogether a motley band quite 500 strong. Then there were a hundred camels and an adequate number of camel-men, no novelties to the Forest School. Add to all this the village folk, whom curiosity had brought there in large numbers.

After we had seen all the elephants, played with the youngest baby, and teased and vexed others until long after the appointed time, 8 o'clock, we ourselves began to show signs of impatience tinged with vague forebodings of disappointment, when a very powerful voice was heard above all the tumult. This was the order for watering the newly caught elephants, which the Mahawats proceeded to obey at once. Two tame elephants were detailed to each new captive, one on either side, with a strong hawser from neck to neck. The majority had been caught only two weeks ago, yet they did not seem to require much tugging or goading from their warders, and went to, and came back from, the water very much of their own accord. While this was going on, the same voice shouted out an order for the *Dharwalas* or beaters to receive blank cartridges and percussion caps, and forthwith Jamadar Sultan Khan was seen dealing them out at the rate of six per gun. It was past 9 o'clock now, and our impatience was pitched a tone higher. We were told that scouts had been posted who were expected every moment to transmit *khabbar* by signal as to the exact position of the wild elephants. At 10 a. m., a bugle call announced that the much wished for *khabbar* had came at last, and thereupon the elephants were made ready for the sport.

Another, and yet another bugle sound, and the beaters filed out and led the van at a fast pace up the Chillawali Rau. They were about a hundred strong, draped in no particular uniform, and armed with fire-arms of all imaginable sizes and shapes, with the exception of a few stalwart Purbias who clung affectionately to the ancestral male-bamboo *lathis*, which, by the way, were by no means less effective than the guns for offensive or defensive purposes. They were closely followed by a long line of trained elephants, not less than sixty in number, headed by the formidable-looking Jamna Parsad whom Nanneh Khan the Captain chose for his mount, all marching on in profound silence. Only four elephants carried pads, all the rest were to participate in the Khedda, although it seemed rather incredible, for they were

armed with nothing more formidable than a strong rope. The students of the Forest School were given a ride on these latter as far as the first halt, which was made where the *Gadawali Sot* joins the main Rau, about four miles from the Forest Chauki at Chillawalla. The *khabbar* was to the effect that there were seven wild elephants near the head of the Gadawali Sot. The beaters therefore parted company here to take up positions along the water-parting of the Sot, and shortly afterwards the Captain proceeded up the Sot, very slowly and cautiously, followed by the students, now on foot, with strict injunctions from him not make any noise.

We proceeded with the rest of the elephants up the Gadawali Sot, which became narrower and narrower as the mouths of successive tributaries were passed. Presently we sighted the Captain coming towards us with a very long face, and we whispered to one another "what's the matter?" The matter appeared to be very serious indeed, and for a while the 'long face' malady was infectious. Before the beaters were well in possession of the vantage points the wily herd had scented our designs and had crossed clean over to the next *Khol*, and there was nothing for it but to beat a retreat with the forlorn hope of once more getting near them in time for a drive that day, for it was past 1 o'clock already.

The students, who had taken up positions high up on the hills, were then signalled to come down, and were told to be particularly careful not to make any noise until the game was over or finally given up, and it must be said to their credit that they obeyed this order very loyally.

Slowly then and not in an enviable frame of mind we came down the Gadawali Sot, and were once again in the main Rau, which we followed up for about a mile, and then entered a tributary to the left called the Patdwari Sot. This Sot splits into two about a mile from its mouth, leaving a triangular peninsula between the arms, the third side being formed by a precipitous cliff the crest of which is the main water-parting of the Siwalik range. At the point of junction of the two streams there is a very steep knife-edge spur on the east or left bank, and a hill with a moderate declivity—over which, in fact, the elephants had entered this Khol—on the opposite side. We took up our positions on the former, from which we could command a full view of the forest clad peninsula where the elephants were hiding. Meanwhile, the *Khedda elephants* spread themselves along the streams across which alone was escape possible for their besieged brethren.

No sooner had this manœuvre been completed than the guns which were so long invisible, began firing from the heights overlooking the peninsula. Presently there was a movement in the forest, boulders rolled crashing down, bamboos and forest trees cracked, and in a small glade we became aware of seven wild elephants mad with fear and rushing helter-skelter through the

jungle. For ought we knew, they might have been in that very glade ever since we had perched ourselves on our hill, but the unwashed brutes had a grey earthy hue, very different from the glossy slaty black of their domesticated friends, and looked for all the world like huge ant-hills or exposed hill sides, both of which are common in the locality. With incredible agility the well-trained Khedda elephants hemmed them in from all sides, and very soon succeeded in dividing the herd. The main tactics of the Captain seemed to be to avoid frontal attack, and to cut out individuals from the herd as opportunity offered. Each individual so cut out was pursued by several noosing elephants while the remainder kept guard.

The first capture was a female infant about a year old, which was noosed with great ease by Mahawat Allan Khan from Gaindkali. Besides being young the baby was maimed, facts which discounted the value of the capture. Little as she was she seemed to be of a vicious temper, for besides giving desperate tugs at her hawser oftener than any other captive, it was she that did nearly all the trumpeting, and was most troublesome in sundry other ways. The next capture was the largest female in the herd, presumably the baby's mother who, however, never missed an opportunity to disavow the relationship. She was lassoed by Saiti from the neck of Vinayak Parsad, a moderate-sized young elephant, of rather a slim build, who rejoices in only one tusk, but has, nevertheless, helped to capture more elephants than any of his stronger comrades. Next followed in quick succession four others, ranging from 8 to 18 years in age, two of which were males and two females.

But the most exciting event of the day had yet to take place. Of the herd of seven, six were already accounted for, but the huge tusker who was seen towering over the rest, was not forthcoming. He had gone up the peninsula, and no amount of firing had for a time any effect towards dislodging him. Batches of Khedda elephants were then despatched to hunt him out. As soon as he sighted them the gigantic beast rushed down the hill with tremendous speed, smashing everything before him with a terrific crash. In a moment he was down in the Rau, crossed it, and made straight for the hill on the opposite side, and it seemed for a while as if he would cross over again to the Gadawali Valley. The Khedda elephants, however, foresaw this, and after a hard struggle succeeded in heading him back to the Rau. Once in the open, he ran straight down the Rau with a speed which must be witnessed to be fully realized. The mugri-men hammered harder than ever, the Mahawats caused streams of gore to flow down the heads, ears, and trunks of their charges, and the race was furious and prolonged. But the odds were very much against the poor wild brute, whom at last Mahawat Bandu lassoed from Deo Parsad, itself a splendid animal. He was

promptly assisted by Nagendar Gaj, the pride of the Khedda. Then followed a brief period of trumpeting, tugging and rampage, which, however, ceased when about a score of tame elephants closed round him on all sides with their heads and all their might brought to bear on him. Thus riveted he was powerless to move. The fearless mugri-men then crept underneath his huge barrel and hobbled his hind legs with a very tight bandage of hawsers. Examined at close quarters, he turned out to be a fine young animal, for he was not more than 35, with a most splendid head. Altogether he was a most valuable capture, although the tusks were not particularly big, owing, we were told, to his constantly rubbing them on sand or stone, and they had yet to grow.

Thus ended a most successful Khedda operation in which neither a single elephant, wild or tame, was killed or wounded, nor did anything happen to the brave men who participated in it, beyond a few trifling cuts and bruises such as they are fairly well used to.

The *modus operandi* is most charmingly simple, and judging from results, attended a minimum of danger. Each elephant carries two men, the mahawat and an attendant called mugri-walla. It also carries on a small pad a strong cotton rope, 20 to 25 feet long, and about 2 inches in diameter, one end of which is securely tied to the elephant's neck, the other end being formed into a running noose. The attendant is armed with a spiked wooden club about a foot-and-half long, with which he beats the elephant near the root of its tail. Attached to the sides of the pad are the ends of a short rope somewhat resembling a pair of reins. The mugri-walla stands near the root of the elephants tail. With his left hand he keeps hold of the rope to maintain his position. With his right he vigorously plies the club. The manner in which he deftly avoids branches of trees and other obstructions in his way, now by leaning back or swinging round, and now by leaping over them when he is in danger of being brushed off, is simply marvellous. As soon as a wild elephant is approached near enough, the mahawat lifts the noose end of the rope, his attendant promptly lifts the rest of it, and then they together throw it over the head of the desired captive, who is kept running on ahead all the time and never given a chance to turn round and charge. If he has the trunk uplifted, which however he seldom has, the captors try to throw the noose round it, in which case it readily slides on to the neck. But more generally the terrified beast carries his trunk closely coiled, in which case the noose is made wide enough to go both round the head and the trunk. As soon as he feels the rope on the trunk, he lifts it, and naturally shoots ahead with great fury, both actions helping to bring the noose well round the neck. The capturing elephant keeps running after him as fast as it can to prevent strangulation. Almost simultaneously a second trained elephant hastens to the

rescue, and throws another rope round the neck of the captive, Between the two the refractory brute is now steered pretty straight, and presently he finds himself surrounded by as many Khedda elephants as are available, and completely nonplussed. From this moment, his stubbornness gradually wears out, and in about two months' time, the whilom monarch of the forests becomes a willing slave of man, perchance a captor of his kin.

U. K.

VI.—EXTRACTS NOTES AND QUERIES

Woods and Forests in the United Kingdom.

The Report for 1898-99 of the Commissioners of Her Majesty's Woods, Forests and Land Revenue is, as usual, chiefly of a financial nature. The accounts are given in a series of tabular statements dealing with estates bought and sold, lands interchanged, leases granted, revenue received, and expenditure incurred. The report closes with abstracts of the accounts under two great heads, first the Capital and then the Income of the land revenue.

The capital receipts show a balance of £46,717 in cash and £277,559 invested in various stocks. Then follow values of estates sold during the year, amounting to £465,000. These are chiefly premises in Whitehall, sold to the State for the new War Office. Under capital expenditure, £185,338 have been spent on the purchase of new estates, chiefly in London, and £33,254 on the improvement of old estates, whilst most of the surplus cash is invested in India and Railway stock, the total capital account balancing at £596,750.

Of the income account, the gross receipts are £605,639, and the expenditure £111,780, leaving £430,000 to be paid over to the Consolidated Fund for the Civil List, and a balance kept for current expenditure of £63,859. It is evident that the management of this large property, situated in all parts of the United Kingdom, and comprising ground rents and other properties in London, stocks of various kinds, farms, mines, foreshore rights and fisheries, must make great demands on the skill and attention of the Commissioners and their staff. To this large charge is added that of the Crown woodlands, which, although at present financially of small moment, when compared with the bulk of the property, are yet of great importance for the health and recreation of the people and as supplying a certain amount of useful timber, as well as customary rights of fuel, grazing, &c. They may also be used with great advantage for other purposes, as will be explained further on. It

is, therefore, evident that much time and care must be given to the maintenance of these relics of our formerly vast English forests. There are no Crown woodlands in Ireland or Scotland, nor indeed in Wales, though there is much Crown waste land in Wales which might profitably be planted.

It would be well if the area of each separate woodland were given in the report, and also the number of cubic feet of timber and fuel sold, and that used on the estates, as well as their values, which are given now. A fair idea might then be formed of the comparative yield of each woodland area, the detailed receipts and expenditure of which are now separately given.

Revenue of the Royal Forest.

The revenue of the royal forests and woodlands under charge of the three deputy surveyors (Windsor, New Forest, and Dean Forest) during the year was £27,539, and the expenditure on them £22,064, but this does not include all the royal woodlands, such as the forest of Delamere in Cheshire, and the woods of Hazelborough and Salcey in Surrey, besides other smaller areas. The total revenue for these woodlands, which are managed by woodmen under the Crown agents, was £3,313, and the expenditure £1,676. No expenditure for planting can be traced in the accounts for the Windsor Forest, but the total expenditure on plantations elsewhere is £1,400, of which the chief items are £839 for the New Forest, £283 for the Forest of Dean, and £117 in the Isle of Man. The expenditure of £647 on Delamere Forest probably includes some expenditure on plantations, which were much wanted when the writer saw the forest a few years ago, but the amount is not specified. It would be useful if this item were shown for all Crown woodlands.

Mr. Stafford Howard states that the Staple Edge and Blakeney-hill woods, 1,393 acres in extent, in the Forest of Dean, have been fenced, and that these woods will now be closed in accordance with plans for the gradual re-inclosure of the whole 11,000 acres, which the Crown is entitled to keep under enclosure. Mr. Stafford Howard has also addressed the Lords of the Treasury as to the decay of the "Old Woods" in the New Forest, which he states must inevitably perish and disappear altogether before many years, as their enclosure is prevented by the New Forest Act of 1877, and consequently the young growth cannot be protected against the cattle and ponies which graze in the forest.

The select Committee of the House of Commons which sat in 1875 held the opinion :—

1. That these fine old woods were natural woods which had grown up unprotected and untended by man in any way, in the open forest.

2. That as they had sprung up naturally, so young trees would in due course of nature come up to take the place of those that decayed and fell from time to time, and that all that was necessary in places where this failed to occur was to prevent the mowing down of the fern, where there was any young growth amongst it, and here and there to plant young trees of good size, so as to be out of the reach of animals.

Better Protection for Young Trees.

Twenty-two years have now passed, and there can be no doubt that these opinions were erroneous. The incorrectness of the first assumption is shown by the perusal of old records, and of the second by an inspection of the woods. An Act of Edward IV provided for the enclosure for seven years of woods after the underwood had been cut in order to protect the re-growth from being destroyed by deer and cattle, and a statute of Henry VIII. for the preservation of a certain number of standard trees (oak, ash, beech, and others) after the copse was cut. In the seventh year of Queen Elizabeth a survey was made of all Crown woods south of the Trent, and a long list prepared giving the names, acreage, and condition of woods in the New Forest. This list includes many of the present "Old Woods." It is therefore evident from these and other facts quoted by Mr. Stafford Howard that the "Old Woods" have from early times been protected. and are not in any way "natural woods." Secondly, that they cannot possibly regenerate themselves is clear from a careful inspection, for nearly every young plant is devoured by the grazing animals as soon as it appears. Mr. Lascelles, the deputy surveyor, is thoroughly convinced of the decaying state of these "Old Woods," and of the greatly increased rate at which they are now dying and falling yearly, and of the total insufficiency of the young growth. To quote Mr. Stafford Howard :—

There are many groups of naturally-grown trees in the open forest where young seedlings have had the protection of thorns and brambles long enough from the bite of cattle and ponies to grow into trees, but the difference in their appearance and growth from those which constitute the glory of the old woods is that between trees which have come up here and there singly or in small clumps by chance in the open forest and those which have originally been grown in an enclosure in close ranks at first and under good conditions of soil and mutual shelter ; the former are stunted and twisted, picturesque enough in their way, but can never make up for the loss of the latter with their great tall stems and massive branches. Such magnificent woods as these can only be perpetuated by following on the same lines that were adopted when they were first formed.

The Restoration of Delamere Forest.

Each Commissioner writes a short report on the estates which are under his special charge, but Mr. Horner makes no remarks about his own woodlands, though the estate of Windsor Forest clearly calls for notice, owing to the difficulties caused by the excessive stock of rabbits in keeping up a proper crop of trees, and the overthinned condition of many of the woods. The restoration of Delamere Forest is also a task requiring all the skill of a good forester, and some remarks on what is being done there would be of public interest.

The Crown woodlands are the resort of all lovers of nature and recreation grounds for the people, but independently of this popular view of their utility, a large woodland area should be so managed as to afford samples of the best possible economic forest management. Our greatest defect as an Imperial Power is the ignorance our rulers show of the great importance of forestry, and this is specially applicable to our Colonial Empire. The importance is now recognised by all European nations, and the United States of America have also recently taken the lesson to heart. We want areas of well managed Crown forests as training grounds for our home foresters, as well as for those we send to manage the forests of India and our Colonies, and for training professors to teach forestry there and at home.

It is satisfactory to know that a skilful forester, Mr. E. Popert, has been temporarily appointed to assist Mr. Baylis, the Deputy Surveyor of the Forest of Dean, and it is to be hoped that this appointment will become permanent, and that similar appointments may be made in the New and Windsor Forests. It would also give a fresh start to good forestry in England, if the Commissioners could command the services of a first-rate forester at Whitehall, who could bring the administration of the Crown woodlands into as good condition as the rest of the Crown property presumably is.—*Daily Chronicle.*

The Perpetuation of the Canadian Forests.

Step by step the Ontario Government are adopting a timber policy which will eventually accomplish two desirable objects—first, the establishment of extensive saw milling and woodworking plants within the confines of the province; and, second, the perpetuation of a timber supply necessary for the existence of such plants. The adoption of the manufacturing clause was the first step in this direction. This legislation has been upheld by the lower court, and by such a clear and decisive judgment that, even should an appeal be taken to the Imperial Privy Council, no fear of a reverse decision is entertained. But granting

that this legislation should be declared void, it is certain that by some other means the exportation of logs from the province will be prevented.

Michigan lumbermen holding limits in the Georgian Bay district are again operating this winter. They will either erect new mills or contract to have their logs sawn at existing mills adjacent to the limits In either case the great benefit to the province, in comparison with the logs being exported, is apparent.

The second step in the direction above referred to was taken by the Department of Crown Lands in connection with the sale of timber limits held on the 20th ultimo The conditions governing the sale of the limits contained the following clause :—"The said timber berths will be sold subject to the further condition that no license for the cutting and removal of pine trees shall issue after the expiration of ten years from the 30th of April next, and that all pine trees remaining on the limits after the expiration of ten years from the 30th of April next shall be the property of the Crown. This is the first instance in which a clause of this character has been embodied in the regulations governing the sale of timber limits. It is one of paramount importance to the province and to the pub.ic, particularly in view of its relation to the forestry problem.

Heretofore the licensee of a timber limit could, by paying the annual ground rent, maintain the limit in his control for an indefinite period. In some instances the limits have been purchased entirely for speculative purposes, the licensee paying the ground rent and renewing his license each year, relying for his returns upon the growth of the young timber on the limit. This prevented the government from applying any system of reforestisation to the property. In other cases lumbermen have taken off the most valuable timber, but still retained possession of the limit, without, however, adopting the necessary precautions against fire. As a result the young timber has frequently been destroyed.

Under the new regulation the land will revert back to the government at the expiration of the ten years' lease, which, it is only reasonable to expect, all the timber of value will have been cut off. The government will then protect the young timber from fire by employing the necessary fire rangers. In this way, the timber supply will be perpetuated. This new condition will also, we believe, have a tendency to reduce the quantity of timber offered to the public by the government, as in order to realise the full value of the timber, the quantity sold to be taken off the land within ten years will have to bear some relation to the demand for timber products during that time.

There is little doubt but that this provision will be embodied in all future licenses for the cutting of timber on Crown lands. So far, then, as timber lands sold henceforth are concerned, the

government will be placed in a position to apply a practical system of forestry. The next question to be considered, therefore, is the perpetuation of the supply on Crown lands sold previous to the adoption of the ten-year clause in the regulations. A partial solution of this question might be found by putting into effect the recommendations made by the Ontario Forestry Commission in their preliminary report presented to the legislature in the spring of 1898. Clauses 3 and 4 of the recommendations read as follows:—

"3. That for all unworked limits on which the ground rent shall be two years in default on the termination of the present license year, the license shall not be renewed, but that the berths be held by the Crown as forest reserve."

"4. That license-holders be not allowed to cut any trees for logs smaller than will measure 12 inches across the stump two feet from the ground, unless under special forest conditions, with the sanction and under the supervision of the district forest ranger.

It must be gratifying to the members of this commission that the government have taken a step in advance of the recommendation. In their final report which will be laid before the House at the forthcoming session, a line of policy will no doubt be outlined which will greatly assist the government in their further work of reforestisation.—*Canada Lumberman.*

A French view of Forest Work in India.

Monsieur Roger Ducamp, an Officer of the French Forest Service, writing in the *Revue des Eaux et Forêts* for December last, pays an interesting and flattering tribute to the work done by the Indian Forest Department, as well as to the influence which this work has had and will have in inducing the colonies of other nations to place their forests under a proper conservative and scientific treatment. M. Ducamp has during the past year been deputed to examine and report on the forests of Indo-China. As has so often happened in other countries, the forests here are being gradually destroyed. The writer says, "Annam and Tonkin, as well Cambodia, Laos and Cochin China possess forests of the very greatest value. But this value has already been considerably diminished, and is continually getting less and less, due partly to the ill-treatment of the forests by natives, partly to the reckless working of the forests by speculators who sacrifice the future of the forests to the wants of the moment or to the greed of gain" The task of placing the forests under proper treatment is discussed, and the difficulty realised, but the writer draws comfort from the flourishing state of the forests of British India, forests which are he thinks under very similar conditions to those

existing in French Indo-China. Further, to make clearer what the state of the forests in British India is, a concise review of the Inspector-General's Review of Forest Administration in India for the year 1896-97 is given. It will be remembered that many of our Forest Officers received their training at the Forest School at Nancy, and it is very gratifying for them and for the Department as well as for the Government of India under whose wise policy so much has been achieved to know that the good work which has been done in India in saving the forests from destruction is so well recognised in France. It is even more satisfactory to note that the example thus set is having such widespread influence throughout the world, for America, Australia, Ceylon, Cape Colony, Siam, and now the French in Indo-China, are all following the example set by the Indian Government.—*Pioneer.*

Forest Fires and Insect Ravages.

The relations of forest fires to insect ravages, insects to forest fires, diseases of trees to insects, and insects to fungous diseases, are not obvious at first sight, but Dr. A. D. Hopkins shows in a report on the insect enemies of forests in the North-West, just issued by the U. S. Department of Agriculture (Division of Entomology), that there is a close connection, and, to a certain extent, inter-dependence, of all these factors in the destruction of valuable forest products. Trees dying from injury by fires, or weakened in vitality, offer favourable conditions for the multiplication of vast numbers of destructive insects. Moreover, trees which have been killed by insects furnish, in their fallen branches, standing and fallen partly decayed trunks, and dry bark, a most favourable condition for the starting, rapid spread, and perpetuation of forest fires. It is well known that forest trees weakened by disease contribute to the multiplication of their insect enemies; therefore, the study of the insects associated with unhealthy forest trees should lead to results of economic importance. As an example of insects contributing to the spread of fungous diseases, Dr. Hopkins reports that the heartwood of the white fir throughout the region examined by him was commonly rendered worthless by decay as the result of wounds in the living bark made by Scolytus bark beetles.—*Nature.*

Absorption of Nitrogen by plants.

From experiments made on *Pisum sativum*, *Polygonum Fagopyrum*, *Avena sativa, and Sinapis alba*, Herr L. Richter concludes that of these plants, the pea only, and not mustard, buckwheat, or oat, has the power of making direct use of the free nitrogen of the air; and that this power is independent of the tubercles. Combination with nitrogen in the soil takes place where there is otherwise a deficiency of assimilable nitrogen.—*Journ. R. Micro. Soc.*

Madagascar Rubber.

The Madagascar rubber of commerce is believed to be chiefly obtained by the natives from various species of *Landolphias*, the principal one being *L. madagascariensis*, though a short time ago a new rubber plant discovered in the south proved to be a species of *Tabernæmontana*. In the *Comptes rendus* (129, 349), M. Henri Jumelle gives an account of the identification of the rubber plant known to the natives as "Piralahy" or "Vahealahy." This is a climbing plant which is found in all the forests of Boueni, at Majunga, Andriba, and in the valleys of the Ikopa, Betsiboka, and Menavava. A botanical description of the plant is given in the paper, and from this it appears that it is a new species of *Landolphia*. This view is confirmed by M. K. Schuman, an expert on the genus to whom the specimens were submitted. It is well distinguished from *L. madagascariensis*, but resembles *L. crassipes* in many respects. It has been named *Landolphia Perieri.*

To obtain the rubber, the natives cut the stem into pieces and allow the latex to drain into a suitable vessel. It is then coagulated by the addition of lemon juice or crushed tamarind fruit. In the dry season the plant yields very little latex, and this coagulates spontaneously, while in the rainy season the milk is much more fluid, but only yields about 6 per cent. of caoutchouc. The caoutchouc is stated to be of excellent quality, and only contains a small percentage of resin.

M. Jumelle examined the latex obtained from the plant during the rainy season, and observed several points of considerable interest. The latex was prevented from coagulating by the addition of ammonia. It had a density of ·996, which lower than that of most latices containing caoutchouc, and was at first thought to indicate the presence of a large proportion of caoutchouc. This, however, was not so, for, as already stated, the latex only yielded 6 per cent. of caoutchouc. The low density of the latex is explained by the low density of the contained caoutchouc, and the absence of other substances in solution. The density of the separated rubber is ·910, whereas that of Para rubber is ·920, and 100 grams of the solid matter obtained by the evaporation of the latex only contains 8 to 10 grams of substances other than caoutchouc. Neither glucose nor starch was present in the latex. The globules of caoutchouc in the latex are small, measuring from ·0020 to ·0022 m. m.; those in the latex of *Hevea braziliensis* (yielding Para rubber) have a mean size of ·0035 m. m.

Another interesting point in which the latex from Piralahy differs from most others is that coagulation is not readily brought about by boiling or by the addition of alcohol. When the latex is boiled, coagulation only occurs in proportion to the amount of evaporation, and the rubber is not entirely separated until the

evaporation is complete, while to bring about the coagulation with alcohol it is necessary to add to the latex four or five times its volume of absolute alcohol. M. Jumelle found, however, that the coagulation could be readily brought about by the addition to the latex of a number of reagents, many of which have no action on other latices. These included sulphuric, hydrochloric, acetic and citric acids, caustic potash, alum, the sulphates of magnesium and sodium, chloride of sodium, the nitrate and sulphate of calcium, and the oxalates of potassium and ammonium.—*Imperial Institute Journal, November 1899.*

Alcohol from Prickly Pear.

M. E Rolants, in the *Annales de l'Institut Pasteur*, says that the Barbary fig (*Cactus opuntia*) which is very similar to the Indian *Opuntia Dillenii and Opuntia Ficus indica*, may be advantageously employed for the production of alcohol. The yield of alcohol at 100 per cent. was found to be from 40 to 60 litres of alcohol per 1000 kilos of fruit, according to the richness of the fruit in fermentible sugar. The yeasts used were six in number, the best returns being from a logos yeast and a champagne wine-ferment.

Germination of Heritiera littoralis.

M, J. G. Boerlage describes, in the *Annals of the Buitenzorg Botanical Garden*, the contrivances by which the seeds of this tree, belonging to the Sterculiaceæ, and widely distributed on the shores of the Eastern Archipelago, are protected from the injurious effect of sea water, when the fruit falls into the sea, permitting them to escape only when thrown upon the shore.

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New processes for extracting Rubber.

The *Revue des Cultures Coloniales* has a series of letters on the above subject which will interest a number of our readers. It will be seen that there are two processes which combine chemical action with mechanical force. In one case the chemical used is soda, in the other case it is just the opposite, *viz.*, sulphuric acid. Both of these immemorial antagonists will here do the same work, *viz.*, dissolve the cement by which the cell walls adhere together, and thus render the cells liable to be disintegrated and washed away. The first letter is from M. Godefroy-Lebœuf, and may be abridged to the following effect :—

" I had at first contemplated solving the problem by means of chemical operations. We were far from suspecting that there was a much simpler method. Two of the museum officials, being engaged in pounding the bark, preparatory to the use of certain solutions, observed that the mere pounding eliminated a lot of impurities. Persevering in their efforts, they found that practically all the bark disappeared, the rubber particles began to adhere, and eventually formed a purer sample than the average of imported rubbers. The process is remarkable as permitting the extraction of the whole of the gum from the smallest fragments of wood, bark and twigs which may contain any. Even with the commonest implements possible, that is to say a pestle and mortar, I guarantee to extract an appreciable quantity of gum from plants no more than 6 months, or even 3 months old, from the germination of the seed. The quantity obtained is sufficient to raise the question whether it may not be industrially possible to cultivate rubber as an annual. The bark must be dried. I can say nothing about green materials. The process refers to the Landolphias and Hancornias. I think, without having tried them, that it would be equally applicable to the genera Ficus, Willughbeia, Urceola, Parameria, Mascarhenasia, Cryptostegia, and in short to all plants which when dried contain fibres of rubber. The following is the

rationale of the process. As the plant tissues dry up, the rubber coagulates, so as to result in a bundle of fibres, stalks, roots, bark, &c., which is after all neither more nor less than a very impure sample of rubber. The impurities have to be got rid of. Take a bit of bark of "thol," Landolphia Hendelotii, dry it, and pound it in a mortar for a minute. Then pass it through a fine sieve. Ten per cent. will go through as dust. Rub the mass between the hands, more dust will come away. Repeat the operations five or six times, and you obtain a magma composed of fibres of rubber mixed with particles of bark. When tired of pounding it, put it into hot water, even boiling, for a short time only. Turn it out into a sieve, and a lot more particles of bark will come away in a fairly strong solution of tannin. It might even pay to recover the latter, if the water were used at a temperature not exceeding 60° C. Now pound it again in the sieve, the splashes will stick to the sides and may be removed by washing. After a short time you will have a little mass of rubber containing only about 10 per cent. of impurities. A little more patience would remove even this. Refining is done by passing the product between well wetted rollers, and the final result is a perfectly pure sample. I shall soon have in use an apparatus for turning out a ton a day.

The Landolphia Hendlotii easily yields 6, 7, 10, 15 per cent. of its dry weight of bark, say 7 per cent. as the average. Thus 10,000 kilogrammes of bark would give 700 kilos of rubber. Taking the price of bark as 100 francs per ton on the market, the cost of extraction as 70 fr. for 70 kilos bark, we get 70 kilos rubber for 170 fr. The process can be applied anywhere, and if the purification is not to be pushed to the final stage, nothing but the most primitive apparatus is requisite.

As to the mode of exploitation of these climbers which throw up shoots from the stool, I suggest that planters should try the following experiment :—Let them divide their land into 10 equal parts. The first year, cut and treat in the above manner all the crop in No. 1, and so on consecutively, year after year, with the others. There will thus be 10 annual coupes, and the yield will certainly be such that they will not hesitate to enlarge the scope of their operations. I will engage to obtain from even the richest climbers, in one operation, ten times more gum than could be obtained by bleeding; and I treat not only climbers fit for bleeding, but also those which contain very little, even plants of a few months old, giving an appreciable yield.

With the Landolphias the work is fairly hard, the bark being tough, but with Hancornia speciosa, the job is quite easy. This bark only contains 5 or 6 per cent. of rubber, as obtained by my primitive methods, but the bark being very friable is at once reduced to dust and the rubber forms a mass with very little effort. I cannot find a better analogy for the process than that

of the extraction of gold from quartz. Gold exists as such in the quartz, rubber exists as such, coagulated among the fibres of the bark. Pound the quartz, pound the bark, throw away the refuse, gather up the gold and the rubber, there is the whole matter.

The process is even more suitable to the habits of the black races than is that of bleeding. To obtain rubber the negro can only work during fixed periods. He must climb about trees, choose his plants, and cut or incise them properly When he will have nothing to do beyond slashing and destroying, he will be in his element. The women will do the pounding in their rice or grain mortars, and the negro will rather bring in to the factory a ton of half refined stuff than 100 kilos obtained pure by bleeding. For this reason the process seems likely to greatly increase the production of rubber in Senegal, in the Soudan, the Congo, and our other African possessions, and thus make the fortune of our colonies."

The second letter is from M. Dybowski, Director of the Colonial Garden at Nogent sur Marne, and Inspector-General of Colonial Agriculture. The essence of it is as follows :—

"This question has been studied for some months now at the Jardin Colonial, but with a view to supplementing the laboratory experiments by results of commercial utility, M. Hamet, the Soudan explorer, has been requested to furnish details of the plant established at his important factory, and of its results. Since last December, some five tons have been experimented on. The bark, either whole or pounded, is stewed at 130° C. in a 5 per cent. bath of soda lye. As set forth in an important note communicated to the Academie des Sciences on 20th June 1892, the intercellular cement of the woody tissues is formed of xylane, lignine, and vasculose. The two former are soluble in a soda solution, and the dissociation of the tissues is thus rendered possible. All that remains to be done is to roll the pasty mass between disintegrating rollers, a continual washing being kept up the while, and rubber comes out in a continuous sheet. Samples can be seen at the Colonial Garden at Nogent sur Marne."

The third letter is from M. Faber, a Civil Engineer, and its principal points are the following :

"Many of your readers may be glad to hear of a process due to a French Chemist, M. Deiss, who has worked it on a fairly large scale, up to 500 kilos of rough material at a time, and has obtained excellent results. The process is very simple, capable of being worked in places far removed from any industrial centre, and extracts at little cost the whole of the rubber contained in the bark of dead trees or climbers. The bark is soaked for some days in a solution of sulphuric acid of 50 degree Beaume strength. This decomposes the woody portions without attacking the rubber. The mass is then taken out of the acid, drained, washed in water,

and passed between laminating rollers under a stream of hot water. The woody portions are crushed into sand and carried off by the water. The rubber, after several rollings, comes out in sheets from between the cylinders in a perfectly pure condition. The washing water is collected, decanted from the sediment, and evaporated to recover the acid contained in it. This is quite good for repeated use, and the loss is small. All the plant required consists of a few baths and rollers of hard wood or cast-iron, since the rolled material by that stage contains only a very little very weak acid. The rubber so obtained is in every way equal to the best bled product.

The bark and climbers contain rubber to the extent of from 5 to 15 per cent. of their total weight, or a mean of 10 per cent. That is to say, 100 kilos of bark yield 10 kilos of rubber. About 800 litres of acid are required to work up 500 kilos of bark. About 70 litres of acid are lost out of this quantity. One man working for one day can manage the whole 500 kilos of bark. These 500 kilos yield about 50 kilos of pure rubber, at a cost of 70 litres of acid and the price of his labour. The 70 litres of acid cost about 4 francs, and the labour about the same. This comes to about 16 centimes per kilo of pure rubber. In some colonies the acid is dearer, and the labour cheaper. In most cases a cost of 14 to 15 francs must be reckoned on, say 30 centimes (3 pence or 3 annas) per kilo of pure rubber. At the present price of rubber this cost of production is insignificant.

The idea of extracting rubber from dried bark is now a comparatively old one. In searching for proofs of priority for the Deiss process, I found several patents based on two distinct ideas. One set aimed at dissolving the rubber out by means of solvents, the other sought to destroy and remove the woody matter by mechanical force and by washing.

In the first class come the following patents:—

Blanchard and Vivier 1894,—dissolve the rubber in tetrachloride of carbon.

Zurchers—1898—uses turpentine.

DeWever—1898—uses petroleum.

Levilly—1892—uses any solvent of rubber, such as toluene benzine, ether, petroleum, sulphide of carbon.

Friswell and others in England—1897, use toluene

M. Deiss, who is a maker of carbon sulphide, had already tried it, but given it up.

The second class of patents is represented by—

Arnaud—1892—various patents.

All these patents seem to be rather theoretical than practical, and I do not know that any of them have been worked commercially. In any case it is certain that the Deiss process, thanks to

its simplicity and profitable nature, will soon be largely used in several colonies, and is actually at work in French Congo."

There is also a separate article by M. Villis based on a report of Mr. Parkin on certain rubber plants in Ceylon. The following is an abridgement :—

"The ideal rubber tree should possess numerous laticiferous vessels, all freely communicating with each other and containing nothing but rubber globules suspended in water as an emulsion. None of the Ceylon trees approach this ideal, but all differ, some more some less. *Hevea* has a very pure latex, but the vessels have not free communication. Consequently many incisions have to be made in order to extract the whole of the latex. *Castilloa* has a much more complete system of communication, but the latex is neither pure nor rich *Manihot Glazehovii* (Ceara) has very little inter-communication, the latex is very impure and contains but a small percentage of rubber. The practical requirements are :—

1. To find a good tree, of rapid growth, furnishing the greatest quantity of rubber at the earliest age.

2. To extract the latex with the least labour and in the purest state.

3. To extract from this the pure rubber with the least labour and cost.

4. To obtain the rubber in as dry and antiseptic a state as possible.

Of the above species, the *Castilloa* best fulfils the second condition, for the latex is very fluid, comes off easily, and requires few incisions. *Hevea* comes second, and *Manihot* last. The coagulation of the rubber has often been a very simple process, consisting simply in allowing the latex to dry. From this point of view *Hevea* is the best, for its latex is almost pure rubber, but when a centrifugal machine is employed, this superiority disappears, for all the species give the same quality of rubber. If the centrifuge is not used, some other chemical or mechanical expedient must be adopted. The latex of *Hevea* is suitable for chemical treatment with acetic acid or corrosive sublimate. *Castilloa* latex is more suitable for mechanical processes, *viz.*, skimming, two or three times repeated. As in the case of butter it is here that the superiority of the centrifuge becomes apparent.

Mr Parkin experimented as to the best localities in which to make the incisions, and has shown that it is not worth while making cuts anywhere but in the lower ten feet of the trunk He also thinks that the leaves and twigs do not contain true rubber, but a substance that might be called *viscine*, not at present worth the trouble of trying to extract. Mr. Parkin has also studied the methods of bleeding. For *Hevea*, the classic V incision is the best, For *Castilloa*, mere oblique cuts will suffice, since each cut

empties a fairly large area. The latex is collected in little boxes, slightly curved on the outer side, the spaces between the box and the tree being filled with clay or wax. The box is held in place by a small nail which is pressed into the bark with the thumb. In the case of *Hevea* a little ammoniated water is put into the box to prevent coagulation. Only one side of a tree is bled during a given season. The principal defects in the preparation of the rubber are in sufficient drying and putrefaction. The latter can be guarded against by the use of antiseptics such as creosote and corrosive sublimate For coagulating *Hevea* rubber, acetic acid and corrosive sublimate give equally good results, but the latter sometimes leaves behind in the substance traces which may reduce its value, *Castilloa* not being very plentiful in Ceylon, simple skimming is recommended, as this process is efficient, and the quantity of juice available is not sufficient to require chemical apparatus.

VI.—EXTRACTS, NOTES AND QUERIES

Imperial Forest School, Dehra Dun.

DISTRIBUTION OF PRIZES.

Prize day at the Imperial Forest School, Dehra Dun, was held on Monday, 2nd April. Mr. Ribbentrop, C. I. E., Inspector-General of Forests, opened the proceedings by calling upon Mr. Oliver to read his report, which was as follows :—

" Mr. Ribbentrop, Ladies and Gentlemen, Students of the Imperial Forest School,—In July last, as you are aware, the school lost the services of its Director, Mr. H. C. Hill, who left to officiate as Inspector-General, and afterwards proceeded on leave to Europe, otherwise there have been no important changes in the school staff. The Deputy Director, Mr. Gleadow, and Mr. Gradon were both away for a time on privilege leave, and during their absence Mr. McIntosh from Madras, and Mr. S. Carr from Burma, were temporarily deputed to the School.

" In addressing you last year, Mr. Hill drew attention to the satisfactory increase that had taken place in the number of candidates wishing to enter the school. This year the increase has been still greater, no less than 111 candidates having presented themselves for examination. Of these 70 have qualified, and the applications for admission have been in considerable excess of the number the school can accommodate. The class which is now passing out of the school, at the commencement of the course, numbered 38 in the upper class (including one who failed last year owing to illness, but who, I am glad to say, has now been successful), and 11 in the lower class. Eight students left the school for various reasons, so that at the close of the course there were 31 in the upper class and 10 in the lower class. The results of the final examination, I regret to say, have not been altogether satisfactory, 7 students in the upper class and 3 in the lower class having failed to gain certificates. Insufficient previous education no doubt accounts for most of these failures, but I have noticed that a good year is often succeded by a bad one, and I fear that in some cases want of application has been the cause. I would take this opportunity of impressing on the students now at the school that without unremitting hard work and attention at lectures they cannot hope to attain success. On the other hand it is encouraging to note that the marks obtained by the successful students are not below the average, and that honours have been gained by Jamna Das, a Punjab private student in the lower

class, whom I have much pleasure in congratulating. Applications have already been received from Local Governments, Native States and from Siam for men to fill 24 existing vacancies, so I trust none of the private students will remain long unemployed.

"The Board of Control has awarded medals to the following students for proficency in special subjects:—*Upper Class*: Botany, S. V. Audinarayana Aiyar; Surveying, H. A. W. Gaudoin; Physical Science, S. V. Audinarayana Aiyar. *Lower Class*: General Proficiency, Jamna Das and Harnam Das. The latter was specially good in sylviculture.

"The prizes of the year provided from funds or presented by Mr. Ribbentrop, Mr. Gamble, the Members of the Board of Control and the School Officers, have been awarded as follows:—The Campbell-Walker prize, for the best student from the Madras Presidency, S. V. Audinarayana Aiyar. For best practical work in the upper class, H. A W. Gaudoin, 1st; C. H. Hearsey, 2nd (Messrs. Gleadow and Oliver's prizes). These two were so nearly equal that it was decided to give a second prize. Best practical work in the lower class, Thamman Singh (Mr. Dickenson's prize). Best note book on Forestry and Forest Engineerining, upper class (Mr. Smythies' prize), C. H. Hearsey. Best note book on Forestry and Forest Engineering, lower class (Mr. Gass' prize), Thamman Singh. For the best Herbarium (Mr. Gamble and the Board of Control's prizes), S. V. Audinrayana Aiyar and Jumna Das, equal. Mathematics (Mr. Oliver's prize), Jumna Dass. For the best Athlete among the passed students of the year (Mr. Ribbentrop's prize), C. C. Chill. A prize has also been awarded from the Brandis Prize Fund to Forest Ranger J. P. Gregson for an article in the *Indian Forester* on 'An Injurious Beetle in the Chittagong Forests.'

"The health of the students has been good, but I regret to say that Mr. Barlow, of the Indian Museum, who lectured on Zoology, was taken ill while at the school and died shortly after his return to Calcutta.

"The Deputy Director, Instructors and others who have from time to time lectured on special subjects, have I know been unremitting in their endeavours to raise the efficiency of the school teaching, and I wish at the same time to acknowledge the help which the members of the forest and office staffs have always readily afforded. Our best thanks are also due to the Members of the Board of Control and to Mr. Duthie and Mr. Reynolds for the careful and patient manner in which they have conducted the oral examinations. It is to be regretted that Mr Boutflower, the Director of Public Instruction, who was good enough to visit us during the earlier part of the examinations, was unable to remain and take part in the discussions on the various matters affecting the school, which were put before the Board. His advice on these matters would have been most useful.

"In conclusion it only remains for me, ladies and gentlemen, to thank you for the interest you continue to take in the welfare of the school—proved by your presence here this hot afternoon—and to wish you students, who are now leaving us, all possible success in your future careers."

Mr. Ribbentrop then said :—"Mr. Oliver, Professors, Ladies and Gentlemen, Students passed and present,—This is the last time I stand before you as President of the Board of Control, and I will not inflict myself on you for long. Dearly I should have loved to have departed amidst the flourish and with a halo around me of an exceptionally successful year ; but fate ordained it otherwise, and the results of the examinations have been exceptionally disheartening, as regards the large percentage of failures. The reason for this is not far to seek. The fact is a considerable number of students, the majority of those who failed, came to the school with an insufficient knowledge of English to follow the lectures, and were thus entirely unable to assimilate even a fraction of the wisdom of their professors. Poor fellows, it was hardly their fault that they did not pass. In my opinion they ought to have been weeded out during early part of the course ; thereby saving us the present disappointment, and the students who failed and their relatives a considerable amount of heartburning.

"There can be no question about it that the reason ascribed for the majority of the failures is the correct one, and that they are not due to teaching above the head of the average students ; for amongst those of the Madras Presidency, who as a rule have a better knowledge of English than those gathered from other Provinces, only one failure is recorded during the last five years, and more often than not the Madras students have held the most prominent position amongst those who passed out. If further proof was required that in the present instance the failures were chiefly due to want of familiarity with English, this is fully supplied by the written answers, especially in Zoology, which would be highly amusing had they been concocted at any other institution than our Forest School.

"There are, however, also one or two who failed on account of want of application, and with those I have no sympathy. There is no honours man amongst the students of the upper class, but the top man has done very well and only just failed to catch the eyes of the judges. Some others have also done creditably, and a good proportion satisfactorily.

"A feature of the year is the abrupt break between those who passed and those who failed. These latter gave the Board no trouble in considering their cases, they failed well. In the lower class, Jamna Das has gained honours, and I congratulate him. The rules of the service shut the door of the Provincial

service against him This is unavoidable, as the business is conducted in English, but there is a side door, the open sessame of which is strenuous study of that language. I would advise him and others similarly situated to devote all their spare time to this, and then, when their Conservators can certify that they have a sufficient knowledge of the language, to get their Government to send them back to Dehra for a course in the Rangers' class. With the knowledge they have gained in the lower class course, they should have the best chance of passing out, perhaps even in one year, and the improved prospects are surely worth the trouble. I have now to say farewell to this school, which I have seen deve.op and which is dear to me

"Farewell to you, Mr. Oliver and Professors, with the sincerest thanks for all you have done for me, officially and privately, and with the earnest request and hope that you will preserve friendly feelings towards me when I am vegetating away from India. Farewell to you passed students, to all of whom I wish a prosperous and useful career, and to you students who have still a delightful year of study before you at Dehra. May you pass out every one of you. It would be pleasant news to me.

"When I contemplate that this is my last visit to Dehra, and that I shall see this charming station, where I have spent many a happy hour, and the familiar faces which surround me, no more, I feel sad and grieved. But this sadness, this grief, are alleviated by the thought of the many kindnesseses I have received here during the course of my frequent visits. These thoughts I assure you, ladies and gentlemen, will for ever live in my memory. I trust you will forgive the paucity of thanks as expressed in words. Believe me I feel them, they are quick within me, and that is the very reason I cannot say more. Good-bye, and may God bless you all."

At the request of Mr. Ribbentrop, Mrs. Gradon then distributed the prizes and certificates, after which the proceedings were closed with cheers for Mr. Ribbentrop, the Board of Control, the Director, and the visitors.—*Pioneer*.

Western Australian Timbers.

A number of specimens of the useful timbers of Western Australia have been added to that section of the Colonial Collections of the Imperial Institute; they comprise polished specimens of *jarrah, karri, tuart, red gum, black-butt,* jam wood, mallett, morrell and banksia, among them being also some remarkable pieces of jarrah, which have been in use for forty or fifty years, *viz.*, a beam from the roof of St. George's Cathedral, Perth, which was erected in 1844—this beam was removed in 1895; a

portion of a plank removed in 1895 from the Upper Brunswick Bridge, which was erected in 1862; portion of a pile which was for thirty years in Bunbury Harbour; and a portion of a fence-post which had been about fifty years in the ground. Parts of the surfaces of these specimens have been planed up and polished, and to all appearance the timber is, in each case, quite sound and fit for many more years' service. The following notes on the timbers describe their characteristics and uses :—

Jarrah, *Eucalyptus marginata*, is the most valuable and most plentiful timber tree in the forests of Western Australia. It is estimated that there are 8,000,000 acres of jarrah forest in the Colony, of which 1,052,400 acres are leased. The timber is a reddish hardwood of close, interlocked grain, very durable in water, and of great strength, both transverse and tensile. In addition to its great value for railway-sleepers, and for street-paving blocks, for which it is already extensively employed in the Metropolis and in several provincial towns, the wood is largely used in Western Australia for furniture and joinery, being easily worked and susceptible of a fine polished surface. The price of jarrah in London at the present time is 2*s.* 3*d.* to 2*s.* 6*d.* per foot, cube, and the market for it is active, supplies not being at present equal to the demand.

Karri, *Eucalyptus diversicolor*.—This tree is abundant in Western Australia; it attains colossal proportions, stems having been measured to a height of 300 feet without a branch, and with a girth of sixty feet at the base. The timber is light red, of great transverse strength, and elastic, but not so easy to work as jarrah. Karri is in steady demand in the London market. The value of the total timber export of Western Australia, which consists almost exclusively at present of jarrah and karri, has been as follows, for the years named:—

1895, £88 146; 1896, £116,420; 1897, £192,451.

Tuart, *Eucalyptus gomphocephala*.—This wood is of a light brown colour, heavy, durable and tough. It is used in the Colony for railway waggons, wheelwrights' work, and ship-building. The timber shrinks but little, does not split while seasoning, and is altogether remarkably free from defects.

Red gum, *Eucalyptus rostrata*.—This timber is one of the most highly esteemed of all the eucalypts, being heavy, hard, strong and extremely durable, either above or under ground, or in water. Next to jarrah it is the best Eucalyptus wood for resisting the attacks of the teredo and of white ants; hence it is much prized for fence-posts, piles and railway sleepers This wood must not be confused with another red gum of South Western Australia, *Eucalyptus calophylla*, the timber of which, though strong, light and useful for spokes and fence-rails, is not durable underground.

Jam wood, *Acacia acuminata.*—This is a small tree, abundant throughout extra-tropic Western Australia. The wood is of a dark reddish-brown colour, close grained, hard and with a fragrant scent, from which it derives its name. The timber should find a ready sale in this country for ornamental work.

Black-butt, *Eucalyptus patens.*—This tree, the black-butt of South-Western Australia, is not the same species as the black-butt of South Queensland and New South Wales; the latter being *E. pilularis*, one of the best timber-yielding trees about Sydney. The timber of *E. patens* is so tough as not to yield to ordinary splitting processes, and is therefore useful for various wheelwrights' work; it has also proved durable underground.

Morrell, *E. pilularis oleosa.*—This is one of the smaller Eucalypts. The wood is remarkably hard, splits freely, and is used for spars, rafters, fence-rails, wheelwrights' work and agricultural implements. It is of a red tinge, and sinks in water even when dry.

Wandoo, *Eucalyptus redunca.*—The white gum tree of Western Australia. The wood is of a pale colour, hard, tough, heavy and durable. It is specially prized for all kinds of wheelwrights' work.

Banksia, or Honeysuckle.—Western Australia is rich in *banksias*, no less than 39 species being recorded by Bentham as indigenous to that Colony. Many of these produce beautifully marked wood which could be used to a large extent in the finer and more costly cabinet work, such as inlaying, etc.

The three principal Western Australian timbers, Jarrah, Karri, and Red-gum, have been tested as to their physical properties for application in engineering and building construction, by Mr. W. H. Warren, M. I. C. E., Professor of Engineering at the University of Sydney. The following tabular statement gives the principal results arrived at :—

..	Weight of test specimen in pounds, per cubic foot.	Transverse strength Modulus of rupture in pounds, per square inch.	Compressive strength. Breaking load in pounds, per square inch	Tensile strength Breaking load in pounds, per square inch	Shearing strength. Breaking load in pounds, per square inch.
Jarrah (*Eucalyptus marginata*)	56·2	14,195 12,060 12,687	5,859 6,030	18,026 17,292	1,847 1,783
Do. do.	67·8	15,775 16,625 14,500	7,880 7,559	11,672 17,197	1,911 1,978
Red gum (*E. calophylla*)	66·2	11,728 13,975 6,515	6,174 5,679	22,725	1,509 1,521
Karri (*E. diversicolor*)	59·9	9,946 9,387 11,117	6,251 8,018	19,920	1,401 1,370

Imperial Institute Journal.

The Bamboo Forests

(DENDROCATAMUS STRICTUS)

OF

THE JUMMOO AND KASHMERE STATES.

It was with great interest that I read an article on the working of D. Strictus in Debra Dun, in a recent *Indian Forester*. Unfortunately I have not got the volume in question before me, but the chief points which I remember are :—

(1) Whether the large expenditure due to cleanings is balanced by the superior quality, and the enhanced value of the culms in the clumps so treated.

(2) The practical impossibility of conducting these cleanings in a sylvicultural manner over a large area without a very largely increased staff of officers.

(3) Whether it is easier to err in over-cleaning a clump and so impairing it's vitality, or to under-clean and so to find the clump, when working it again, in as bad a condition as before.

(4) In which direction the rhizomes naturally shoot, *i. e.*, towards the centre or the outer edge of the clumps.

(5) Whether the crooked culms, caused by a congested clump, cannot be straightened when cut by the process of firing for their hardening.

Before discussing the above I should like to give a short description of the forests here, and their present condition. The two forests I propose writing about are named "Bagnai" and "Jasrota," their respective areas being 1,345 acres and 1,462 acres. A year ago I demarcated these forests and divided them up into blocks for future working on the 3-year cycle principle, with a cleaning preceeding, each cutting by a year. A rough plan for their working, with a description of the tracts was drawn up, the areas surveyed and maps constructed. Of the two forests "Bagnai" is the better, containing a nearly pure bamboo growth with only a comparatively small admixture of trees and shrubs of the broad-leaved species. It is also interesting to note that these forests are situated on the southern slopes of the lowest range of hills in Jummoo State, about 15 to 20 miles from Pathankote Railway Station, having a probable maximum height of 2,000 feet, with a range of 1,000 feet from their base to ridge. On the ridge at it's highest point a curious admixture of chir pine and bamboo is to be met with, but this is not so common as in the "Boodi" forest, which has not been taken in hand as yet, and which is separated from the "Jasrota" forest by the "Oogli" river. Needless to say on the northern slopes of these hills chir pine is to be found, but their growth is stunted, owing to excessive heat and the low elevation.

In the "Bagnai" and "Jasrota" forests there are many difficulties to be met with and overcome, the chief of which is

the tremendous amount of damage done by lopping and grazing. The source of this constant menace to the welfare of the forests is to be found in the fact that during the cold weather numbers of gugars and gaddis (nomads), with their ever-increasing hordes of goats and buffaloes when driven down from the higher ranges by snow and cold, find a splendid haven with an unlimited supply of fodder easily procurable in these forests Nothing had been done till recently to prevent the ravages done by these depredators, and it is no exaggeration when I state than when standing on a prominence one gazes on a sea of top-lopped clumps, not one having been spared. The clumps in fact generally consist of a number of stumps from 3 to 10 feet in height. It is a miserable sight, as not only is the vitality of the bamboos greatly impaired by the annual lopping, but until it is stopped there can be no revenue made (working sylviculturally), as bamboos a few feet in length have no or hardly any market value. Added to the above must not be forgotten that there can be no reproduction by seed, owing to the heavy grazing, and so we have forests which are being slowly but surely killed.

However, steps are now being taken to prevent these depredations, and none too soon. Here we have a forest whose clumps are terribly congested, whose vitality is impaired by lopping, and where there is no reproduction by seed, in fact no forests could have possibly been worse treated than these have in the past. Keeping these facts in mind, we will pass on to the questions raised :—

(1) In a forest as above described it is impossible to make a first cleaning without a great deal of expense, owing to the very congested state of the clumps and especially so as, owing to the condition of the culms, nothing practically could be realized from those cut during the cleanings. If, however, the clumps are left to themselves, but lopping and browsing stopped, I doubt whether the result would be satisfactory, as the growth would be much slower owing to want of light, and the culms very crooked owing to want of space.

(2) This is the great difficulty in all systematic working over a large area. The only remedy appears to be either in reducing the areas and working each as an independency, or greatly increasing the Forest Staff.

(3) This very much depends on the clump itself; if very congested, it naturally requires a great deal more cutting to get at the culms inside. It also depends on the condition of the forest and the state of the clumps. In the "Bagnai" and "Jasrota" forests it certainly would be easier to over than under-clean.

(4) This I think is a question not so much of the natural direction of growth taken by a rhizome but as to whether this route is open. If a rhizome meets with any obstruction such as a

mass of old buried stumps, stones, &c., it must necessarily be turned off it's course and so take another direction wherever most convenient, whether up or side-ways. The natural course of a rhizome would presumably be straight ahead, provided there was no obstruction; at all events it would follow just below the surface of the soil and then head freely out as a culm, but in practice what do we find, a mass of twisted misshapen rhizomes. The natural tendency of growth would be, I should imagine, towards the outside of a clump and not towards the centre, in order to spread and find more room. However, from observations in the "Bagnai" and "Jasrota" forests, the direction taken by the rhizome would appear to be very eratic, as new culms spring up wherever there is space and light.

(5) If the culms are slightly bent when cut they may be straightened by firing, but in a very congested clump, the general condition of a culm is more like that of a half-coiled snake, being sometimes twisted into very weird shapes. It is not practicable to make these straight.

From the above remarks it would appear that bamboo forests differ much in their constituency, &c., and so the only course to be taken is to make such rules as are especially adapted to each individual case. Where one finds forests in good condition, such as those in Dehra Dun, which have been carefully reserved and kept from harm, possibly systematic cleanings are not advisable, but in such forests as I describe, I think the only method of procedure to follow is to clean and bear the expense as cheerfully as possible, at all events until such a time when the clumps have attained their normal conditions. When this stage has been attained, the operation may be modified to suit the exegencies of the case, and to keep down expenses.

Until some new and satisfactory system is devised, the method of cleanings in partly ruined forests of bamboo seems to be the only feasible one. However, my experience being but small, I should be very grateful for information and general guidance, from the officers who have been and are in charge of such bamboo forests as those in Dehra Dun, to help me on my way.

E. A. T. RADCLIFFE.

The Botanical name of Karri.

I should be glad if you or any of you readers could give me the botanical name of the Australian wood called "Karri." This wood is now being placed on the Calcutta Market.

A. E. W.

As will be seen from the extract printed above, the botanical name of *Karri* is *Eucalyptus diversicolor*.

HON. ED.

A destructive fungus on Xylia dolabriformis.

The Fungus attacking Xylia dolabriformis (Pyinkado), described by Mr. Troup on page 19 of our January number, has been identified at Kew as *Fomes fulvus*, Fries. It is said to be a wound parasite which would be very likely to attack portions of a tree injured by fire.

Market Rates of Teak Wood.

It may interest Burma Forest Officers to know that Teak wood can be procured in Eastern Bengal at cheaper rates from Bombay than from Calcutta. Why is this?

A. E. W.

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Note on the Myauktaung Teak Plantation in the Arracan District, Burma.

Having occasion to consult with the Deputy Commissioner of the Arracan District on some questions affecting the working of the Chittagong Forest Division (Bengal), the two districts lying adjacent to one another, I went down to Akyab in March 1899. Whilst there the Deputp Commissioner, Mr. St. John Leeds, gave me the history of a small Teak plantation he had in his district, at the same time asking me whether I could manage to see it and let him have an opinion as to what tending it required. I may mention that the Forest Officer is as yet unknown in Arracan. The name of the plantation is Myauktaung, and it was situated some 70 miles up the Kolandyne River. Having a day at my disposal before it would be possible for me to start on my return journey to Chittagong, I consented to do this and with all the more alacrity when I found that *en-route* I should be able to get glimpses of the Arracan Forests, about which very little appears to be at present known.

It was on questions connected wth the cutting and export of produce from these Forests that I had come from Chittagong. I trust in another place to be able to make a few remarks on these Arracan Forests, none of which are reserved or in any way under the management of the Forest Department.

A seventy-mile or so run up the river brought me to the Teak Plantation situated in the Kyauktaw Sub-Division, a few miles above the Sub-Divisional head-quarters, also named Kyauktaw Between the Kyauktaw Station and Myauktaung I noticed several small Teak Plantations of a few acres in extent on the banks of the river, probably 10 to 15 years old, with a height growth of 20 to 30 feet. Soon after passing these we arrived at the Myauktaung Plantation, the origin of which is as follows :—

The plantation is situated on the Eastern bank of the Kolandyne River in the Kyauktaw Sub-Division. In 1876 the then Deputy Commissioner gave a grant ot land, 27 acres in extent, to one Re Mra Tuewa for the purpose of planting teak trees.

Re Mra Thewa planted a number of teak trees and is said to have spent a large sum on the work. The land was free from rent for 12 years under the grant, and since the expiration of the term of exemption the present owner Maung Aung Tun W, son of Re Mra Thewa, who died, has paid land revenue at Rs. 60-4-7. per annum.

The owner now wishes to cut down the plantation. The Deputy Commissioner gave him the requisite permission provided he paid Rs. 7-8 per ton as royalty, the plantation coming under Class C. in the order contained in Revenue Secretary's letter No. 24/11-9, dated 1st February 1895, and the royalty being leviable before the owner cut the trees. Against this decision Maung Aung Tun W. *appealed to the Commissioner, the appeal being dismissed* in the middle of March 1899. I should mention that the original grant of the land appears to have been illegal. The Deputy Commissioner recorded the following order when he issued the grant on the 27th July 1876 :—"I have inspected this plantation and am willing to give a potta rent free for 12 years under Class I Section 11, page 153, Clause 5, of the Revenue Rules. The experiment deserves every encouragement." The rules under which the grant was given are the Rules and Directions for the Revenue Adminstration of the Province of British Burma of 1865. These rules did not permit the issuing of a grant for this purpose, and the grant seems to have been *ultra vires*. Such was the history of this plantation and the position of affairs when the Deputy Commissioner asked me to inspect it.

On approaching the plantation I noticed that it is very irregular in shape, its greatest length running in a direction parallel to the river, portions of its Western edge being within 60 to 70 yards of the river bank.

I had been led to expect that the plantation had in no way been touched or cut over since the date of its formation 20 to 32 years ago. *On walking into it, however, the first thing noticeable* were stumps of cut down trees. In places where only small trees had been removed, their extraction had to some extent done slight good as their removal partook of the nature of a thinning. In most instances, however, the trees removed were large ones and their extraction had had a disastrous effect on the canopy overhead,* which in places is much too open and thin, as proved by the telltale patches of sunlight observable on the ground.

Generally speaking the trees are well grown for their age, some 20 to 23 years, with good straight clean boles, except where indiscriminate hacking has led to the formation of side branches. The height growth is good varying from 20 feet to as much as 50 feet in the better grown portions of the plantations, with girth, of all sizes upto 3 ft. 9 in. and in a few cases over. A tree was measured with a girth of 4 ft. 6 in. and a height of 45 feet. A careful inspection of the whole area occupied by the plantation showed me

that the growth varied greatly in density, chiefly, if not entirely, due to the unauthorized felling that had taken place in it. As a whole the plantation compared very favourably with the Sitapahar Teak Plantation, planted by the Forest Department in the Chittagong Division on the banks of the Karnafuli River, or, I should say, with the portions of the latter that were left intact by the cyclone of October 1897. So favourably impressed was I with the growth that I should strongly recommend that the Mayauktaung plantation be carefully looked after and protected from indiscriminate hacking, which can only result in its ruin.

During the growth of the plantations two things have militated against its proper development :—

(1) The trees were I think originally planted in lines, and young seedlings and saplings that died off were, in most instances, if not in all, not replaced. Thus gaps ensued.

(2) No thinnings of any kind had been made in the early stages and the trees removed in the later stages were the best and largest and those that, generally speaking, should have been left; the owner's object being to get the best price possible for the produce he illicitly removed, the interests of the plantation itself not being taken into account.

These fellings have in places resulted in serious interruptions in the canopy overhead with a consequent formation of side branches low down on the trees thus left too much exposed. Where no cutting of any kind had taken place, the young poles were suffering from want of space and light to develop in.

I was able, although the time at my disposal was all too short, to make rough measurements over 3 selected sample plots, representing fairly well stocked, thinly stocked, and densely stocked forests.

I append these measurements, giving in each case the average girth at 4 feet from the ground and height of the trees on each plot. The heights are taken to the summit of the crown of the tree.

SAMPLE PLOT I.—Area 12 yards. × 12 yards.

23 Trees measured.

Average tree	...	1' 8" girth.
	...	29' height.

SAMPE PLOT II.—Area 12 yards × 12 yards.

26 Trees measured.

Average tree	1' 9" girth.
	34' height.

9 Stumps counted on the area.

SAMPLE PLOT.—Area 12 yards × 12 yards.

24 Trees measured.

Average tree	1' 9" girth.
	30' height.

6 Stumps counted on the area.

The following are my recommendations for the future treatment of the Plantation.

(a) That the Plantation be carefully gone over by a Forest Officer with the requisite knowledge, and thinned where necessary at as early a date as possible. Unless this operation is most carefully done, the Plantation will rapidly deteriorate and be ruined. In the thinning, badly formed trees, dominated trees, sickly and dead ones would be removed, and, where necessary, a dominant tree that is interfering with the growth of promising young trees around it would be cut out.

(b) I should feel inclined to recommend that the areas, where cutting has taken place and where the covering overhead is consequently very open and no thinnings are required, should be planted up with young teak plants.

(c) All small broken topped trees should be cut back so as to obtain a good strong coppice shoot in their place.

(d) All stumps of trees that have been illicitly cut should be carefully dressed with a knife or axe, in order to endeavour to get a good coppice shoot from them.

(e) Fire must be rigidly excluded from the area occupied by the plantation. I noticed, at the time of my visit, that a fire had recently burnt over a portion of the area occupied by young poles that had either been planted later than the rest of the plantation, or had originated by natural regeneration I was unable to determine which, owing to want of time. Fire must be kept out, and to accomplish this object I propose that a broad line of say 20 feet be cleared all around the plantation, and that this line be kept absolutely clean of all jungle, leaves, &c., during the hot weather months. This will minimise the danger of fire crossing into the Forest from outside.

(f) Cattle should be excluded from the plantation. I noticed that grazing was taking place, and damage was being done by the cattle to young seedlings and poles.

The above is a short scheme of the treatment which I recommend should be put into force at once, should it be desired to preserve this promising young teak plantation. Proposals for its later treatment could be drawn up when the above points have been attended to.

The plantation is now 25 years old, and the experience that can be gained from watching its growth will be great, and will enable the Forest Department to form an opinion as to the possibility and desirability of introducing the teak on a large scale into the Arracan District. If it is possible to prevent it, I should most strongly deprecate the owner of the plantation being allowed to fell it wholesale. Should such a course be unavoidable as long as it remain in his possession, I should recommend that the Deputy Commissioner take it over, if

practicable, the owner being indemnified for the expenses incurred by him to date.

In *conclusion*, I trust that the above note, as to the future treatment of the plantation, may prove of use to the Deputy Commissioner, Akyab.

CHITTAGONG;	E. P. STEBBING,
February 1900.	*Assistant Conservator of Forests*

Sterculia urens as Cattle Fodder.

Sterculia Urens.—Hooker's Flora. Bri. Ind., Vol. I., page 355 Vernacular names—Kadóyo, (Guj and Káthiáwádi); Karra, (Hindi); and Pandhruk, Karai, Saadhol, (Marathi).

This tree grows here and there on the Bardá Hills of the Porbandar State (Kattyáwád); and indeed, in some of the valleys of these forests it grows so very luxuriantly that the paths leading to these valleys are known by such names as *Kaddyá-Kedi*, or the path of the Sterculia trees. The tree is leafless in the cold weather, and from its white appearance, it can easily be recognized even by a casual observer. The Marathi name Panhruk means white, and Sál-dhol signifies white bark; these being the names by which the white tree Sterculia urens is known. The people of this state are well acquainted with the tree, as from incisions made in the tree a white gum exhudes, which the Ratearis (professional graziers) collect and sell in the markets of Porbandar.

With this exception that it yields a gum the tree is of no use, as its wood is of very inferior quality, even as fuel. But, the use to which it has been put at this time of famine has proved it after all to be a tree of great utility in the forests of this state, as its twigs and bark have saved thousands of cattle from starvation. The way in which the Ratearis of the hills, and the villagers in the vicinity feed their cattle on this tree at present is as follows :—

• The twigs and smaller branches of the tree, under three inches in diameter, are cut and split into small pieces, about half to an inch in diameter, and with these the cattle are fed. Not only this, but the bark is also used in the same way, the bark being stripped from the stem and from all branches which are more than three inches in diameter. In the case of cattle, which had not previously been habituated to this of sort of food, the wood was mixed with cotton seeds or with the flour of any grain. But after becoming accustomed to it, the cattle will eat it quite as a readily as they will eat cotton seeds, their ordinary food. By this food the cattle have not only been fattened, but the flow of milk

among buffaloes and cows has been increased, and they have kept so healthy that many of them have been in calf even at this time. In fact they require no other food when once they become accustomed to this new fodder. A head load of the twigs or bark of the tree is quite sufficient for the day's feed of two heads of cattle; and a head load costs nothing, as the forest, have been thrown open by the State to all persons, and the cutting of Sterculia is allowed free. Thus, this very nourishing food which is the chief source of fodder at the present time of scarcity, has been the means of saving a vast number of the buffaloes, cows, and bullocks owned by the people of this state. It is, in fact, almost the only source of cattle fodder at this time of famine.

Next to Kadáyo, the following three trees are also largely used as food for cattle at this time of scarcity, *viz* :—

(1) *Sterculea colorata*.—Hooker's Flo. Bri. Ind., Vol. I., page 359.

Vernacular.—Kodárro.

(2) *Bombax malabaricum*.—Hooker's Flo, Bri. Ind., Vol. I., page 349.

Vernacular.—Shemalo.

(3) *Odina wodier*.—Hooker's Flo. Bri. Ind., Vol. II., page 29.

Vernacular.—Maredo.

The above three trees are mentioned as food for cattle in Dr. Watt's Dictionary of Economic Products of India, Vol. III., page 407. But it is a wonder that Sterculia urens, which is also, as I have shown, a very useful tree for this purpose, is not enumerated in his list of food and fodder for cattle.

I hope wherever Sterculia urens grows in forests, cattle will not suffer from starvation, but that it may be made use of as explained above. The Forest Department of this State will in future strictly reserve Sterculia urens as it has proved itself to be a most important source of food for famine stricken cattle.

JAIKRISHNA INDRAJI,

Curator of Forests, Porbandar State,

(Káthyáwád).

The Tapping of Rubber Trees in the Charduar Rubber Plantation, Assam, 1899.

In the Assam Secretariat letter No. 9 Forests—388R. of 23rd January 1899, the Chief Commissioner's sanction was given to the experimental tapping of the rubber trees in compartments Nos. 1 to 4 of the Charduar plantation. The following report shows the results of the operations:—

Results of Operations.

2. The accompanying statement gives these results:—the areas of the operations, the numbers of trees tapped, the yield in rubber, the average yield per tree and per acre, and the cost of the operation. The

areas include the above four compartments, and also the 8 acres of the Bamoni Hill plantation in Tezpur, the results for each being shown separately.

3. In the statement attached, a distinction is made between :—

(*a*) Trees tapped, which had been previously untapped, or only moderately tapped.

(*b*) Trees previously heavily tapped, or suppressed trees.

The results were, from the four compartments :—

for (*a*) trees ·90 lbs. per tree ;
for (*b*) „ ·23 „ „ „

The total yield of the four compartments was 2,947 lbs. of rubber. As will be seen from the following remarks, the low outturn is probably partly due to rain, which, during the operations, washed away a considerable proportion of the rubber before it was dry.

The rubber was sent to London and sold, the results appear below.

Description of Operations.

4. Mr. D. P. Copeland, Deputy Conservator of Forests, Darrang Division, in his report on the operations which he conducted, refers to the close supervision required to prevent theft, and describes in detail the operations of tapping, collecting, drying, etc.

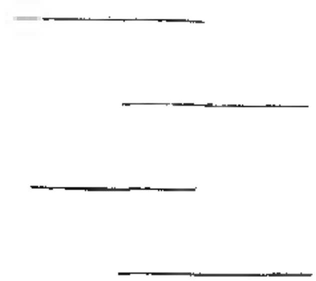
In accordance with instructions, the girth of the bole and the measurements of the crown were recorded in the cases of 10 per cent. of the trees tapped, and these trees were labelled.

The work of tapping and collecting the rubber, which commenced on 24th January, and continued till 31st March, was at first tried with Mikir and a few Garo coolies on the daily wages usual in the locality—8 annas a day. Owing to the unsettled weather, it was found that this system was too costly, the rain necessitated stoppage of operations from time to time, and work elsewhere had to be found for the tappers ; again, the coolies had no interest in the outturn. After the tapping operations had been completed in compartments Nos. 1 and 2, the work in compartments Nos. 3 and 4 was therefore given out on contract, under close supervision to prevent theft, to a Nepalese contractor at Rs. 30 a maund, and to local Assamese, not so good at the work, at Rs. 20 a maund, the cleaning being arranged for separately at one ann a seer. The results in the yield per tree and cost of tapping and collecting were therefore better in the cases of compartments Nos. 3 and 4. It appears that the Nepalese are the best men for this work.

Position of cuts.

In compartments Nos. 1 and 2, treated by Mikir labour, the system adopted was to make the cuts regularly one foot apart down the stem of the tree, these cuts being horizontal, and not exceeding 8 inches in

length and 2 inches in width. Aërial roots and branches, less than a foot in girth, were not tapped. It was afterwards found that no fixed rule could be laid down, and that the experienced Nepalese tappers make the cuts 2 feet, and often further, apart, and the length of the cuts varies with the girth of the bole. Again, they avoid making the cuts immediately one below the other, and locate them alternately, as below:—



The position of the cuts appears to have more effect on the yield than their number.

In compartments Nos. 3 and 4 the contractor included the tapping, and the work of pulling the rubber off the tree after coagulation. The rubber takes four or five days to "set" on the surface of the tree before it can be collected. This work of collecting took as long as the tapping.

Collecting.

One of the essentials for success is said by, Mr. Copeland, to be settled weather. If rain occurs within two days of tapping, the milk is washed away, and the loss is heavy, while what remains on the stems loses part of its elasticity, becomes brittle and discoloured. The operations were greatly hindered by the frequent rain, both in outturn of rubber and in cost of labour, since work had to be stopped and employment found elsewhere for the labour.

Weather.

As soon as the rubber was pulled off the trees, the cuts were coal-tarred, 17 barrels of tar being used for the 322 acres.

Tarring.

Unless the rubber was cleaned immediately after collection, pieces of bark and chips of wood and other impurities imbedded in it were difficult of removal. The work of picking out these foreign matters was done by contractor at one anna a seer, the loss in weight on the first weighments being about 8 per cent.

Cleaning

After this cleaning, the rubber was spread to dry—at first in the sun—but as this seemed to make some of the rubber brittle and discoloured, and made some to melt, the system of drying in the shade was adopted. The loss from dryage is reported to be about 1 per cent. only.

Drying.

Weighment of the rubber was made for each compartment separately on the spot, as soon as it was pulled off the trees. A reference to the statement will show that for compartments Nos. 1 and 2, the yield from the trees of the (a) class was 0·79 lb per tree. For compartments Nos. 3 and 4, however, the trees of which were tapped by skilled labour, the yield was 0·97 lbs. per tree, or 22·8 per cent. more than for compartments Nos. 1 and 2. Mr Copeland thinks the difference would have been still more marked, had it not been for the rain, which did more damage to rubber in course of collection in the last two compartments than in compartments Nos. 1 and 2.

Yield.

The yield per tree is given in the statement, as also the yield per acre.

The statement gives the cost of the operations of tapping the trees and collecting and cleaning the rubber, which comes to seven annas two pies per pound of rubber. At the foot of the statements, however, are given the details of other expenditure incurred on the operations, the whole being about three times the above sum per pound of rubber. To this it is necessary to add the cost of freight to London, insurance and agents' expenses, as is done below.

Cost of Operation.

Mr. Home was present during part of the operations.

5. In future operations, the work should be done earlier in the season, so as to avoid the rains of February and March.

6. The question of re-tapping the same trees next season and annually, as originally proposed, is under consideration.

E. G CHESTER,

Officiating Conservator of Forests, Assam.

Statement showing the result of the tapping of rubber trees in Compartments Nos 1 to 4 of the Charduar Rubber Plantation.

Particulars.	Compartment No. 1	Compartment No. 2	Compartment No. 3	Compartment No. 4	Total	Barnoni Hill	Grand Total.
1	2	3	4	5	6	[illegible]	8
Area, in acres	66 07	73 45	79 80	94·31	313·66	8 00	321·66
Number of trees tapped							
(a) Previously untapped or moderately tapped	596	610	824	1 035	3,065	183	3,248
(b) Previously heavily tapped with the object of killing them	520	504	116	6	1,146	447	1,593
Suppressed and badly grown	33	60	272	473	838	107	945
Total trees tapped	1,149	1,174	1,212	1,514	5,049	737	5,786
Outturn in lbs. of rubber as weighed on collection—							
(a) From trees previously untapped or moderately tapped	466	481	842	965	2 754	56	2 820
(b) From trees previously heavily tapped and suppressed trees	145	174	60	77	446	29	475
Total outturn as weighed on collection in lbs.	611	655	902	1,042	3,210	85	3,295
Average yield per tree as per above weighments—							
(a) Per previously untapped or moderately tapped trees (approximate) lbs.	·78	·80	1·02	·93	·90	·30	·87
(b) Per previously heavily tapped and per suppressed tree lbs.	·26	·29	·15	·16	·28	·05	·19
Outturn of rubber dried, cleaned and re-weighed lbs.	576	607	848	916	2,947	76	3,023
Loss by dryage and the removal of impurities	35	48	54	126	263	9	272
Yield of rubber, dried and cleaned, per acre lbs.	8·6	8·3	10·6	9·7	9·4	9·5	9·4
	Rs. As. P. (Compartments No. 1 and No. 2)		Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
Cost of tapping	209 13 0		295 6 10	330 3 7	1,112 1 5	27 8 6	1,139 4 11
" of collecting	276 10 0						
" of cleaning	124 15 0		48 1 9	48 9 6	221 10 3	2 9 9	224 4 0
	611 6 0		343 8 7	378 13 1	1,333 11 8	29 13 3	1,363 8 11
Average cost per lb. of cleaned rubber	0 8 8		0 6 6	0 6 8	0 7 3	0 6 3	0 7 2

The Parcellaire system of grazing in Nellore, Madras.

Government of Madras, G. O. No. 66, dated 31st January 1900

In the above Resolution of the Government of Madras, in the Revenue Department, sanction is given to the introduction of a scheme or "working plan" for the regulation of grazing in the State Forests of the Nellore District. The Scheme is known in Madras as "the parcellaire system of grazing"

The resolution to begin with, contains an interesting history of the grazing policy pursued in the past in the Nellore District, beginning with the system which was found in existence when the district first came under British rule, and following it up to the present year. It is not necessary to enter into this question at present. Suffice it to say that the grazing question has always been one of importance in this district, largely on account of the Nellore breed of cattle having long been renowned and consequently very profitable to the owners. The value placed on this undertaking may be gathered from the fact that in 1860-61, no less than Rs. 1,05,903 were paid in grazing fees

For our purpose it is only necessary to mention here that in the year 1890 "it was decided to abandon a proposal to form "village forests" which had previously been entertained, and to constitute all available Forest or grazing areas into reserved forests or reserved lands under the Forests Act, or else throw them open for the unrestricted use of the villagers." This classification having been carried out the grazing has since been regulated in these areas by the introduction throughout the district of a uniform system of grazing arrangements under cover of permits at the sanctioned rates. In other words, district grazing permits have beed issued everywhere and direct to the cattle-owners, at fixed rates per head of cattle.

So much for the system at present in force in the district. We will now proceed to quote below *in extenso the scheme known* as the parcellaire system of grazing, which has has been sanctioned and is being introduced. This scheme has apparently been drawn up by Mr. C. M. Mullaly, the Collector of Nellore, we presume in consultation with the District Forest Officer, Mr. Foulkes.

The parcellaire system sanctioned for the working of the grazing areas in Nellore, 1900.

1. It is proposed to divide the district into three Zones—the Coast, the Central and the Western Zones.

The coast zone consists of reserves for which working plans are either ready or are in course of preparation. In these there is an active demand for produce, and the grazing will form part of the working plans.

The central zone consists of reserves for which no working plans are likely to be prepared for some time to come. These

reserves, though in some cases adjoining each other, are for the most past scattered and of comparatively small areas, *i. e.*, as compared with the continuous forests of the ghâts, and do not therefore lend themselves, owing to their scattered situation, to their formation under the parcellaire system.

The western zone consists of continuous forests of large area on the Eastern Ghâts and their outliers.

2. Another important factor which governs this division is the fact that the fodder and watering facilities of the Western zone is quite different to those of the plains.

The people of the district have recognized this from all known time, as shown by the practice of the inhabitants of the coast taluks in sending there cattle inland to the ghât areas regularly every year for periods varying from two to six months. Indeed some of the larger cattle-owners send their herds to the Cuddapah and Kurnool Districts. It will be seen then that the western or ghât portion of the district (known locally as the Veligondas and the Yerrakondas) naturally lends itself to the introduction of such a system as that known as the "parcellaire." A further reason for this is found in the fact that the Veligondas, except where broken by zamindari or shrotriem tracts, form large and compact blocks of land which makes efficient supervision possible, and the regulation of opening and closing the grazing in different years feasible. *A fortiori* is this the case when the bulk of the cattle are foreign cattle (as opposed to local village cattle), and it is a matter of indifference to their owners whether they graze a few miles north or south of certain limits, provided that the areas which are opened to them contain sustaining pasture

For the present then I propose to commence by introducing the parcellaire system only in the western portion of the district, and exclude the eastern or plain portion entirely until it is seen what success has been attained in the former. It must be remembered too that selection and settlement has not been completed in the latter, and until this is done it seems premature to take this part of the district into consideration.

3. The Kistna parcellaire system has been taken as a model. Its main features are :—

(1) To equalize, as far as possible, the grazing areas for which separate fees should be paid by making parcelles of from 3,500 to 6,000 acres in extent.

(2) To substitute department management by means of well-paid foresters and watchers for contract and commission systems hitherto in force.

(3) To have quarterly and half-yearly as well as annual grants.

(4) To improve the grazing grounds by—

(*a*) initiating a rotation of closure ;

(b) regulating the number of cattle in each;
(c) manuring and sowing seeds, &c.; and
(d) limiting different classes of cattle to different areas.

(5) To introduce the parcellaire system throughout the whole or main portion of the district.

(6) Provision for goat-browsing in parcelles.

4 In this district it is proposed to adopt the above as a model, but with the following modifications :—

(1) To commence the system in the western or hilly portion of the district with parcelles of 3,500 to 6,000 acres.

(2) To combine departmental management, with the issue of permits by village munsifs on commission and abolish the contract system, as the present leases fall in, *i. e.*, by end of fasli 1311

(3) To issue only annual permits.

(4) To commence the improvement of grazing grounds by—
(a) opening and closing each parcelle every other year, in order to commence as simply as possible; but
(b) it is not proposed to attempt the regulation of cattle yet, as there are no data yet worth going upon.

(5) *It is not contemplated in this district to allow goat-browsing in the parcelles now recommended for adoption.* But a scheme is being prepared to allow goats on a parcellaire system into the extensions of the reserves.

But this is a subject which will be dealt with in continuation of this letter as soon as the scheme for goats is ready.

(6) It is proposed to make a register of all water sources which give an unfailing supply throughout the year, and instead of spending money on manure, to see what steps can be taken to improve the water-supply for cattle or to extend it; this will be a boon always, and in years of scarcity may be the means of saving the lives of hundreds of cattle.

5 The area included within the proposals for this district amounts to 164,411 *acres, made up as follows, working from south-northwards* :—

	Acre.
Rapur range—	
Veligondas A	36,400
Do. B	
Yerrakondas	20,938 *
Udayagiri range—	
Veligondas	*51,293*
Durgam reserve	10,200
Yerrakondas	13,569
Kanigiri range—	
Vedullacheruvu	7,000
Veligondas	25,011
Total ...	164,411

ı round numbers 165,000.

Aiming at 5,000 acres for each parcelle, this gives 33 parcelles. The subjoined table shows in detail each individual parcelle :—

Serial Number.	Taluk.	Range (new re-organization) Nomenclature.	Name of Reserve brought under the system.	Area of parcelle	Years open to grazing
				ACS	
1	Kanigiri ...	Range No. 1 Kanigiri.	Nandanavanam blocks A and B, parcelle No. 1	6,784	1899-1900, 1901-1902, 1903 1904, &c.
2	Do ..	Do	Do do ,, 2	6,483	1900-1901, 1902-1903, 1904-1905, &c.
3	Do ..	Do	Do do ,, 3	5,740	1899-1900, 1901 1902, 1903-1904, &c.
4	Do ...	Do	Do do ,, 4	6,004	1900-1901, 1002 1903, 1904 1905, &c.
5	Do ...	Do	Kanigiri-Veligondas-Vedullacheruvu blocks parcelle No. 5 (a).	4,500	1899 1900, 1901 1902, 1903 1904, &c.
6	Do ...	Do	Kanigiri-Veligondas-Vedullacheruvu block, parcelle No. 5 (b).	2,500	1900-1901, 1902 1903, 1904-1905, &c.
7	Rapur	Range No. II, Rapur.	Rapur-Yerrakonda, parcelle No. 1	5,737	1899 1900, 1901-1902, 1903-1904, &c.
8	Do ...	Do	Do do ,, 2	5,693	1900-1901, 1902-1903, 1904 1905, &c.
9	Do ..	Do	Do do ,, 3	3,030	1899-1900, 1901-1902, 1903 1904, &c.
10	Do	Do	Do do ,, 4	6,478	1900-1901, 1902-1903, 1904 1905, &c.
11	Atmakuru	Do	Rapur-Veligondas blocks A and B, parcelle No. 1	3 950	1899-1900, 1901-1902, 1903 1904, &c.
12	Rapur and Atmakuru ...	Do	Do do do 2	2,770	1900-1901, 1902 1903, 1904-1905, &c.
13	Rapur ...	Do	Do do do 3	5,900	1899-1900, 1901-1902, 1903 1904, &c.
14	Do ...	Do	Do do do 3	6,880	1900-1901, 1902-1903, 1904-1905, &c.
15	Do ..	Do	Do do do 5	3,520	1899 1900, 1901-1902, 1903 1904, &c.
16	Do .	Do	Do do do 6	5,520	1900-1901, 1902-1903, 1904-1905, &c.
17	Do ...	Do	Do do do 7	5,120	1899-1900, 1901 1902, 1903-1904, &c.
18	Do ...	Do	Do do do 8	5 440	1900-1901, 1902 1903, 1904-1905, &c.
19	Atmakuru ...	Range No. III, Udayagiri.	Udayagiri-Veligondas blocks A & B, parcelle No. 1	4,167	1899 1900, 1901-1902, 1903 1904, &c.
20	Do ..	Do	Do do do 2	6,213	1900-1901, 1902-1903, 1904 1905, &c.
21	Udayagiri and Atmakuru ...	Do	Do do do 3	5,120	1899-1900, 1901 1902, 1903-1904, &c.
22	Udayagiri ...	Do	Do do do 4	4,965	1900-1901, 1902-1903, 1904-1905, &c.
23	Do ..	Do	Do do do 5	5,445	1899-1900, 1901-1902, 1903-1904, &c.
24	Do ..	Do	Do do do 6	5,052	1900-1901, 1902-1903, 1904 1905, &c.
25	Do ...	Do	Do do do 7	4,707	1899-1900, 1901 1902, 1903 1904, &c.
26	Do ..	Do	Do do do 8	5 9.1	1900 1901, 1902 1903, 1904-1905, &c.
27	Do ...	Do	Do do do 9	4,321	1899 1900, 1901-1902, 1903-1904, &c.
28	Do ...	Do	Do do do 10	6 392	1900 1901, 1902 1903, 1904-1905, &c.
29	Do ...	Do	Udayagiri Durgam reserve blocks A and B, parcelle No. 11	7,131	1899 1900, 1901 1902, 1903-1904, &c.
30	Do ..	Do	Do do do 12	4,313	1900-1901, 1902-1903, 1904 1905, &c.
31	Do ...	Do	Yerrakonda parcelle, No. 1 ..	4,832	1899 1900, 1901-1902, 1903 1904, &c.
32	Do ...	Do	Do do 2 ..	5,046	1900-1901, 1902-1903, 1904-1905, &c.
33	Do ...	Do	Do do 3 ..	3,691	1899-1900, 1901-1902, 1903-1904, &c.
			Total	165,655	

Thus the 33 parcelles proposed are made up as follows :—

		Parcelles.
Rapur-Veligondas A. and B	...	8
Rapur-Yerrakondas	...	4
Udayagiri-Veligondas and Durgam reserve	..	12
Udayagiri-Yerrakondas	...	3
Kanigiri-Veligondas and Vedullacheruvu	...	6
Total	...	33

It will be seen that each parcelle is a little above or below the 5,000 acres unit, but factors of the locality precluded exact division.

6. *Establishment.*—The essence of any scheme like the parcellaire system which involves the opening or closure of areas in rotation, &c., is to have an adequate establishment to carry out the details of the system, for otherwise the scheme begins and ends by being a mere paper scheme and in practice either never will exist at all or will soon cease to do so after its novelty may have worn off.

The work of the establishment will consist in—

(*a*) Seeing that the proper parcelles are open or closed during the years arranged for them.

(*b*) The checking of permits issued, and seeing that—

(i) no cattle graze without permit ;

(ii) that the numbers specified in the permit agree with the actual numbers grazed ;

(iii) that any laxity in issuing permits by the permit issuing officers, either by carelessness or illiteracy (for some village munsifs cannot write or do so with difficulty), is at once remedied by prompt issue of permits to those desiring them ;

(iv) impounding illicitly grazed cattle not always an easy task on the Veligondas ;

(v) the supervision of the location of cattle "doddies" or pans ;

(vi) the preparation and maintenance of all such information concerning the grazing as may be required not only for immediate use but also for the compiling of data for the future and to enable the system to be gradually improved and made of more benefit to the community ;

(vii) the collection of information regarding all water sources and their capablities during the hot weather ; and

(viii) the preparation of useful notes generally such as the species of grass found on the hills, those which are of good fodder quality and those which are worthless or nearly so, the preparation of stock maps showing the blanks, the specially good grazing areas, the moderate ones, the inaccessible ones, &c. In short, to explore and make a complete reconnaissance of the Veligondas.

Following Kistna as a model the establishment required will be—

Eight special Foresters and thirty-two Watchers.

7. The expenditure involved will be as follows :—

		Rs.
Eight Foresters at Rs. 20 = Rs. 160 ...	...	1,920
Thirty-two Watchers at Rs. 6 = Rs. 192 ...	...	2,304
Total	...	4,224

8. As contemplated under paragraph 6 (vii), one of the immediate uses to be made of the establishment will be an exhaustive examination of the water-supply.

It is not possible at this stage to give more than a mere outline of the manner in which the use of the water-supply can be developed, but the first step will be to classify all water found into two main divisions—

(*a*) Those which dry up in the hot weather.

(*b*) Those which are perennial.

It is the latter, of course, which must be first taken in hand. Once the list has been prepared, it is proposed in communication with the Executive Engineer to prepare a scheme individually by means of which the water may be made available for the greatest possible number of cattle by preventing waste, and to save the source itself from contamination or danger of disappearance by wanton treading by cattle, denudation of growth or other preventable cause, and to save loss by evaporation. It is probable that a little intelligently directed expenditure will thus enable the same water-supply to satisfy a far greater number of cattle than heretofore.

It is quite possible also that some of these water-supplies, which now dry up for part of the year, may be treated in such a manner as to become either perennial or at least to yield water for a longer period than is the case now.

9. *Cattle pens.*—It is proposed to allow the graziers to pen their herds with only simple conditions :—

(*a*) That the permission of the District Forest Officer must be obtained in writing for pens in places approved by him and no other.

(*b*) The number of cattle in each pen must be all registered and licensed.

(*c*) That the grazier engage to place litter in the pen each day. By this means the quality of the manure will be much improved.

10. *The Revenue.*—It is not easy to estimate the revenue which will accrue on the introduction of this system, because there are no real data to go upon and the question is complicated by the fact of the coast taluk cattle going inland to graze, and there is no record to show what zamindari and shrotriem cattle are sent to the Government lands to graze.

The following table shows the cattle of the district (talukwar), *fasli* 1307 :—

Taluk.	Buffaloes.	Cows and Bulls.	Sheep.	Goats.	Total.
Gudur ...	19,331	68,035	30,286	27,247	145,399
Rapur ..	14,108	45,019	73,787	48,932	181,846
Nellore ...	29,778	85,209	25,674	25,036	165,697
Atmakuru ...	21,521	49,459	70,467	31,665	173,392
Kavali	15 925	34,645	32,820	22,485	105,875
Udayagiri ..	10,997	21,413	51,532	28,861	112,803
Kandukur	21,260	47,013	67,389	19,917	155,579
Kanigiri	9,202	19,444	41,294	16,329	86,269
Ongole	28,801	51,960	60,201	20,176	161,138
Total ...	171,423	422,197	453,450	240,868	1,287,938

But all these cattle do not resort to the reserves, nor could the forests maintain them if they did.

In order to arrive at some estimate of the revenue the following process has been adopted. Only those villages which adjoin a reserve have been considered, and the cattle census of these villages has been taken. These cattle have been multiplied by their corresponding grazing fees, which gives a total of Rs. 86,380. But as all the cattle, even of a village adjoining a reserve, are not sent to the reserve, 60 per cent. of this figure has been taken, which gives a total of Rs. 51,828. This figure does not include migratory cattle or the cattle of the coast villages (not adjoining reserves), but which are driven inland every year to the Veligondas for grazing.

It is therefore probable that the figure given above, Rs. 52,000, will be obtained and the difference between this and Rs. 22,500, the past five years' average, shows an increase of Rs. 29,500 for an expenditure of Rs. 4,224, which will certainly be a satisfactory result from a financial point of view.

11. But the parcellaire system must be regarded also from points other than the purely revenue stand point :—

(*a*) The grazing will presumably be improved thereby, and it was to attain this improvement, and thereby encourage *the*

maintenance of the standard of high grade cattle for which Nellore is still famous, that the kancha system was originally introduced. This alone will be the means of indirectly adding enormously to the capital value of the cattle of the district.

(*b*) The only portions of the district where fires are disastrous are the very tracts proposed to be included under the parcellaire system, and it is fair to assume that, having these tracts placed under special control will in a degree minimize these disastrous fires and be the means of assisting these Veligondas to partially attain once more to the state for which they were famous 50 years ago.

(*c*) The (locally) famous Rapur ghât and middle Udayagiri-Veligondas have been subject to deliberate and well contrived thefts in addition to the fires mentioned above, for years past, and it may be further argued that the mere fact of special control will have a large moral influence on the men who have traded illicitly for years with comparative impunity.

(*d*) The minor products of the Veligondas, notably gallnuts, are not properly collected, and there is reason to believe that the mere fact of really sub-dividing the hills and bringing them under control will induce such improved collections that the increased revenue from minor products above will more than pay for the establishment proposed; apart from putting so much extra money in the pockets of the people by the collections of products which are now allowed to go to waste. This is a most important point, for it is these tracts that are especially liable to scarcity and famine, and anything which is likely to add to the employment of the people and their means of subsistence ought to be fostered.

Sleepers

The Haskin process of treating Sleepers.

In the *Indian Forester* for February 1900 we reproduced an article from *The Indian and Eastern Engineer* reviewing certain correspondence which had taken place, anent the introduction into India of the Haskin Process of Preserving Timber. The question is one which has been receiving a good deal of attention, and it has formed the subject of considerable correspondence between various Government and Railway Officers in India. Moreover, inquiries are now being made as to the prospect of using the Haskin process to enable country timber to be utilised for railway purposes. Under these circumstances our readers may be glad to be placed in possession of further details.

"Briefly described, the process is as follows: Into great boiler-like receptacles, 120 feet long and 6 feet 6 inch diameter with one end open, but capable of being hermetically closed in a couple of minutes, truck-loads of timber are wheeled. Air at a temperature of 400 degree Fahrenheit, and at a pressure of 200 lb.

per square inch, is kept in steady circulation through these receptacles by means of powerful special machinery, for a period of about 8 hours. The effect on the timber is not only to kill the germs of all destructive organisms, but to convert the saps, and part of the fibre, into antiseptic preservatives of the turpene-phenol carbolic type, which find birth, and remain, in the very pores and fibres of the wood itself, and so preserve it.

"In all cases a preservative effect is obtained from the products of the wood itself, without the addition of any extraneous material. Tests of sleepers, under heavy conditions of wear and exposure, have been made in America with satisfactory results.

"Mr. Haskin's works are on the site of the old Samuda Shipyard in the Isle of Dogs, close to Messrs. Yarrow and Co.'s works. The machinery, which is described as being of great magnitude, has been all supplied by Messrs. Galloway. Rails are laid through the compressing cylinders, and trollies carrying the sleepers or scantlings to be treated are wheeled right in."

Inquiries were made by the Consulting Engineer for Railways, Madras, from the patentees, the Haskin Wood Vulcanizing Co., as to the conditions under which they would allow the Forest Department in India to work their patents, and also as regards the cost of the necessary plant. Their reply is given below :—

Dated Westminster Abbey, S. W., dated 25th November 1898.

From—The Secretary, Haskin Wood Vulcanizing Company, Ld.

To—The Consulting Engineer for Railways, Madras.

My Directors have now considered your letter and memoranda of the 17th ultimo, and instruct me to reply as follows :—

They think a plant, say, half the size of that now working at Millwall, would probably best meet your requirements, and they estimate the cost of such a plant, delivered f.o.b., Liverpool, will be about £12,000. Such an installation could be fixed at the centres you might consider desirable, and each installation should enable you to treat, say, 450 standard size sleepers per day.

Our terms for assenting to your installation of such a plant in India would be the sum of £2,000 paid down so soon as our negotiations are completed, and a royalty of 3*d.* per sleeper of ordinary gauge and 2*d.* per sleeper of metre gauge and 1*d.* per cubic foot for any miscellaneous timber that might be treated in the vessels.

Should the Government wish to pay a capital sum down in the first instance in lieu of the proposed royalty, this would be a matter for negotiation.

It would be stipulated that apparatus would only be employed for the treatment of materials supplied by the Forest Department for the use of the railways or other Government deparments, and the Company would also specially stipulate that all the machinery should be made and supplied by their sole licensees, Galloways, Limited, Manchester, who have constructed the whole of the machinery at the Millwall works to our entire satisfaction, and

which machinery can be seen at any time by any representative of the Government.

Enclosed is a short specification of plant half the size of that at Millwall.

ENCLOSURE.

Specification of Haskinizing plant proposed to be supplied.

This plant to consist of 2 treating chambers each about 114 feet long by 6 feet 6 inches diameter to be made of best quality of Siemen's Martin steel plates ; the back ends of these vessels to be of a dished shape, and the front ends to be formed of a steel door mounted on substantial hinges with balance weights and arrangement for rapid automatic jointing, the whole being readily operated by one man. The vessels to be fitted inside with an arrangement of pipes for heating, and a set of rails for trolleys upon which the timber to be treated would be carried.

These vessels to be supported by an arrangement of rollers carried in substantial framing to allow of expansion and contraction taking place without putting any strain on the vessels.

A hundred trolleys as before mentioned, to be formed of wrought iron or steel framing, and each fitted with four wheels suitable for running upon the rails referred to.

One horizontal non-condensing air compressing engine with air cylinder having a bore of 18 inches and a stroke of 2 feet 6 inches and with stem cylinder of suitable dimensions ; this engine to be complete in every way and of the most substantial design in every detail.

1 horizontal non-condensing air circulating engine of the proper size and strength.

2 patent Galloway boilers each 28 feet long by 7 feet diameter, made of best annealed steel plates with complete set of fittings, valves, etc.

The whole of the pipes valves for actuating the vessels, machinery, etc., as above described including steam, feed, exhaust, and air circulating pipes with feed pump for feeding boilers, air receivers, heaters and coolers as required, all of the best material and workmanship throughout, delivered f.o.b., steamer in Manchester.

The following is a list of Southern Indian species, which are considered to be structurally and physically fit for railway sleepers, *viz.* :—

(1)	TEAK	*Tectona grandis.*
(2)	MADDI	*Terminalia tomentosa.*
(3)	.. ..	*Terminalia paniculata.*
(4)	IRONWOOD, Iral	*Xylia dolabriformis.*
(5)	VENGAI, or Yegi	*Pterocarpus marsupium.*
(6)	ACHA, or Yepi ..	*Hardwickia binata.*
(7)	SAL .	*Shorea robusta.*
(8)	SOME	*Soymida febrifuga.*
(8)	MANJA KADAMBAI, or Rudrajanapa ...	*Adina cordifolia.*
(10)	SHURALI	*Mesua speciosa.*

Tree-planting.

A descriptive catalogue of the best trees to plant in Cape Colony, with brief instructions for planting, by D. E. Hutchins, F. R. Met. Soc. Conservator of Forests, late Deputy Conservator of Forests, India Published by W. A. Richards and Sons, Government Printers, Cape Town

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Mr. D. E. Hutchins the Conservator of Forests, Cape Colony, has published a very instructive pamphlet on the subject of tree planting, with special reference to the formation of woods; and to the conditions prevalent in South Africa.

The first part of the *brochure* deals with sylviculture, and in a very concise and clear manner the reader is placed in possession of all the more important rules to be attended to in forming artificial woods, either by sowings or plantings. The preparation of the ground, the method of sowing, the preparation and up-keep of nurseries, transplanting, and more especially the distance apart to plant, coppicing, thinning, and the mixture of species are all dealt with briefly it is true, but clearly and to the point.

It must be understood that the pamphlet is written primarily for the benefit of the uninitiated, or for the Forester new to the country. It is not necessary, therefore, to enter into details regarding the subjects dealt with in the work: but a few extracts may be found of interest. To those interested in the subject of Provincial Arboriculture, or roadside planting, Mr. Hutchins would impress upon them the advantages of planting in deep pits, even up to a yard cube of excavation. "On this system watering is only required two or three times till the trees are established. Watering more than this is harmful, and tends to keep the roots at the surface and defeat the object of the big pit. Some years ago I planted over a million trees in yard cube pits. This was in a very hot dry country—Mysore, South India. And these trees came safely through the fearful famine years 1876-77, when all the crops failed for want of rain, and even portions of the indigenous scrub died off."

The following extract sums up the subject of sowings:—"Seed should not be wasted, but it is better to sow too much than too little. Too many young trees are a doubtful evil, and one that is easily met! Too few young trees means filling up with expensive planting or doing all the work over again."

Under "Nurseries," the subject of "damping off" is very clearly dealt with. This is due to a fungus called Phytophthera omnivera, allied to the potato disease The root and the stem are at first quite healthy, but the seedlings rot away at the ground level and fall over in patches.

Young pines are most likely to be attacked before they are pricked out. Late summer sowings, which are sometimes necessary, suffer most. The disease spreads rapidly and creates fearful havoc. It is intensified by damp, dull weather, over-watering, or over-shading. The remedies are :—

(1) Keep the plants as dry as possible ;

(2) Take off all shade ;

(3) Dig out the diseased patches at once, and replace with clean dry sand. The diseased earth is full of spores, carry it away carefully to a distance from the nursery.

(4) To be safe next year have the seed tins or seed beds in some new and distant spot. The old nursery will remain infected with spores, but it is only crowded succulent seedlings that are liable to be attacked. For a full account of this pest see Marshall Ward's "Timber and some of its Diseases."

Again, "a common error in planting is to put the young trees in the ground too deeply. Nothing is gained by this except liability to rot, if water stands above those green parts of the stem that should naturally be out of the ground."

"Inexperienced persons usually plant fruit trees too close, and forest trees too far apart. The standard distance for forest trees in Europe is one yard apart, the trees being put in square, one yard apart between the lines, and one yard apart in the lines. This gives 4,840 trees to the acre. This distance, within narrow limits, is the custom in all those countries in Europe where Forestry is understood and practised as an exact science."

"Wide planting rapidly runs up a terrible bill for weeding and cleaning"

And, lastly, "never go on to new ground till the failures and blanks in the old plantations have been filled in. This is simply common sense, but no rule is more often forgotten in the haste to cover new ground and make a show of young trees."

The second part of the pamphlet deals with the properties, and sylvicultural requirements of the Forest trees which may be planted in South Africa either for timber, shade or ornament. Hedge shrubs are also mentioned, and fruit-growing is only incidentally touched upon.

Under the head of "frost and drought-bearing trees," a list is given of the trees that will best stand the cold and drought of the karoo and the country beyond. This list includes the following species :—Virginia Pencil Cedar, Robinia, Tamarisk, Deodar, Common Cypress, Pomagranite, Jerusalem Pine, Almond, Cypress of various sorts, Juniperus excelsa. Weymouth Pine, Turkey Oak, European Olive, Poplars of various sorts, Catalpa, Cluster Pine, Elm, Eucalyptus, Common Fig, Insignis Pine, Stone Pine, Walnut and Wattle-saligna.

Considerable attention is given to the "tan wattles" Acacias; and is it a curious coincidence that the figure "5" appears to be the Wattle-planters' golden number. It supplies nearly all his working data :—

Seed costs, per lb	5 d.
Quantity of seed to sow per acre ...	5 lbs.
If plants are used a good planting distance is	5 ft. × 5 ft.
Acacia decurrens and Acacia pycnantha should grow in height per year, about ...	5 feet.
Barkstripping should begin in	5 years.
When the diameter of well-grown trees of the above kinds should be	5 inches
Safe estimate of yield of bark per acre ...	5 tons.
Worth per ton about	£ 5.

Experiences with Bears.

On the 9th December last I happened to be in Camp in a warm valley of the Himalayas. The Kanawaras at that time were just bringing down their sheep and goats from the higher elevations to winter in the valley out of the reach of snow A large flock had passed our camp the evening before and bivouacked for the night a short distance away.

On this morning one of them came running to me to say his dog had put up a bear about ¾ of a mile off in a dense undergrowth by the river, and asked me to come and shoot it. I had little hope that the bear would remain until I arrived, but I got my Express and went at once with the man. When we arrived at the clump of bushes where the bear was supposed to be, the man's companion told us that it had just made off towards a '*dabar*' (a huge collection of massive boulders with dense undergrowth)

I felt sure he had found a safe retreat in one of the numberless small caves, and was just talking to the men when we heard the dog bark about ½ of a mile lower down. We rushed off in the direction and eventually located the dog in front of a huge boulder surrounded on the lower side by dense reeds 10 to 12 feet high. It was easy to get on to the rock from above, and we did so. We noticed when ver the dog moved, the reeds nearest the boulders shook, and at first I thought the bear must have got into a cave under the rock, and that the dog was at the mouth.

Soon, however, we got a glimpse of the dog in among the dense reeds some feet away, and at once knew that it was the

bear that was mowing the reeds near the rock. Unluckily the boulder sloped down towards where the bear was and I found that I could not keep from slipping in my nailless boots which I had not had time to change. I hastily began to take them off and had got one off when the Kanawara with me said "he's coming." Sure enough the bear was coming round the rock up the hill towards our end. I took a snap shot between the shoulders and he rolled over yelling and howling, into the dense reedgrowth below. I had not the slightest doubt that he was mortally wounded, as he was only 8 or 9 yards from me when I fired. In the reeds he was out of sight and while I was putting on my boot he made off to the middle of the '*dabar*' again.

We all thought he would take to one of the small caves there, and we wasted our time tracking him carefully through it. He was evidently hit in the lungs and the blood trail was very clear. When we were through the '*dabar*' we found the trail crossed the road and went up the hillside. By this the bear had a couple of hours start, and it was late before we tracked him over most difficult and precipitous ground to a cave in the face of a precipice. We threw stones and tried to make him show himself, but as nothing appeared we grew bolder and crawled along the narrow track to the cave, into which there was no doubt he had gone as he had smudged a rock with blood on one side of the entrance. The cave was in limestone rock and went straight in for 10 feet or so and then vertically down. There was plenty of room for several people to stand in the mouth, but it was impossible to see down. By throwing stones we judged it 20 or 30 feet to where they stopped. There was soft dry earth at the entrance, so the Kanawara inscribed mystic signs to see whether the bear would come our in the night.

Next day we came provided with a short 12 feet ladder, 2 hurricane lanterns and a multitude of ropes. First of all we let a lantern down where it rested 20 feet down. By its light we could see the cave went down further still to the side beneath us. We managed to shake the rope with the second lantern until it went on down past the first out of our sight until it stopped 30 feet down. After some time as nothing happened, we decided to go down. The Kanawara who was as plucky as they make them, insisted on coming down with me. The top 20 feet was like a well about 6 feet broad, but we managed to pitch the ladder in a ledge of rock about 10 feet down on the further side. We then had ropes tied to us, the Kanawara to his waist, I to my belt, the men above being told to keep the ropes just taut. The Kanawara had an American hunting axe of mine and a pronged stick to defend himself, I took my Express. I of course took off my boots and we proceeded down. It was not so difficult after all getting down, but I wonder how we'd have got up again in a hurry.

When we reached the bottom 30 feet down where the second lantern was, we were quite out of sight of those above. The floor

was soft earth and we could stand up comfortably in the middle. We found that the cave went on to the right and left. We soon explored to the left and found the end about 10 feet on. To the right it was more diffiult as the roof became lower and lower and the sides nearer. I laid flat down as far as I could, and at the end about 3 feet from where my head was, the channel turned to the left. It was a small hole about 15 inches in diameter and we both concluded no bear could have got through it, and we certainly could not. We could find no blood just there either though there was some at the bottom near where the second lantern rested. So we came to the conclusion that the bear must have got out, but we could find no marks whatever of his exit. Down at the bottom two blue-bottle flies buzzed round our lanterns, but they may have only been attracted to the cave by the smell of blood.

There however we had to leave it and all our trouble was of no avail. I have no doubt now that the bear did get on through the small hole and perhaps the cave went on a long way more as there must have been some exit for water which evidently drained down the face of the precipice in the rains.

I had no opportunity of visiting the place again to see if there was any smell and so I do not to this day know whether the bear was there or not. I think it must have died, as I have never come across an instance of an animal getting over a lung wound. However bears are exceptional animals and this one must have been ready to hibernate. At that time they have splendid chance of recovering from serious wounds as they are a mass of fat and can just retire into a cave and neither eat nor move giving an opportunity to heal to many a wound which would cause certain death if the animal had to move or eat.

Some time after this I had occasion to shoot a "pi" dog which was stealing some meat hung in a godown. I only used a shot gun with smokeless powder but the vibration at once extinguished the hurricane lamp which was held behind me. I have now no doubt that had I had to discharge my Express in the confined space of the cave that the lamps would have gone out, and the result might have been rather uncomfortable.

Good Kanawara dogs are very plucky beasts but this one was evidently very gun shy as after my shot he could not be induced to go near the track.

Last year on the afternoon of 15th May a couple of these dogs located a bear in a hollow silver fir and the owner brought me '*Khabar*.' When I arrived at the spot, the dogs were keeping guard over the hole, and every now and then would go and sniff at the hole, when the bear would charge to the entrance but would not come out. I waited my opportunity and as the bear charged and the dogs retreated I caught a glimpse of something black in the hole and fired into it.

After that we could not rouse the bear but I was not sure if it was dead, wounded or only frightened from the shot. It was late then so I decided to come back in the morning. The next day we found the bear dead inside the tree, so we set to work to enlarge the hole to extract it. After enlarging it sufficiently we tried to pull the bear out but could not as it was stiff.

One of my "*paharis*" volunteered to go in and push from inside, so in he went, but when we got the bear half out it stuck fast and the poor chap was a complete prisoner inside. However, he did not seem to mind much and after desperate endeavours we got the beast out. The men then sat down at a little distance to smoke and I was examining my firt Himalayan bear, when I thought I heard a faint squeak. I listened intently and sure enough after a little while it was repeated so I knew there were cubs. The *pahari* named "Shounu" who went in before, lit some "*Jogan*" (pine torch wood) used by the hill men instead of oil, and began to examine the inside of the hole When he got in he exclaimed "*Bahut bari jaga, Forest bunglé ki barâbar.*" As a matter of fact it was about 12' by 6' and this must have been a sarcastic allusion to the size of the new rest houses in these parts.

It was really a hole in the side of the hill, the entrance being through the silver fir which was 16 feet in girth. He soon discovered two little cubs about a month old, which we brought up on bottles, and when they were about 4 months old gave them away.

On skinning the bear we found the bullet had hit the base of the skull, and so the beast must by fearful fluke have been killed at once.

ROOK.

VI.—EXTRACTS, NOTES AND QUERIES.

Pyinkado.

In an issue of the "Agricultural Ledger," there is an account of the Iron-wood tree of Pegu and Arrakan. Xylia dolabriformis is a large deciduous tree met with in the Central Provinces, South India and Burma.

Xylia is comparatively scarce in Mergui, South Tenasserim, and the southern portion of Tavoy, but north of Siam Road it is plentiful, though often inaccessible. It is most accessible in the following forests:—Kalemaung Reserve, Kyanshat Forest, Nalkyizin Forest, Heinze Forest. It is plentiful in the forests south of Sinthe, and is also found in the moister forests in the Yamethin sub-division, east of the railway. It is very abundant on the western slopes of the Pegu Yomas, and extending down to the plains. In the Upper Chindwin Forest division it is com-

mon on the left bank of the Chindwin, south of Kindat, down to the borders of the Division on the right bank of the Chindwin southwards from the Sitthaung—Tamu road to the end of the division, and east of the Ayu River. It is easily accessible and very plentiful in most places, except perhaps in the Kubaw valley, where it is scarce. In Burma the flowers uniformly appear in March. In January and February when the old leaves have fallen and the new flush of a bright pink colour replaces it giving the tree a handsome appearance the pods from the previous year's flowering begin to form and develope. If trees are felled in Burma in December or January green pods are found on them which from their colour are scarcely distinguishable from the leaves unless examined closely. The fruits thus remain on the tree till the following year's flowers appear. As the hot weather advances, the thick, woody pods ripen, and while remaining on the tree, or at the time of falling, dehisce and scatter the seeds in all directions. In Malabar, the pods burst on the tree, and the seeds begin to drop from the end of January and continue to the end of March, when the new leaves begin to appear. Throughout the whole of Burma, and in South Kanara, the period of collecting the seed is during the months of March and April.

Commencing with the Tenasserim Division it is stated that Pyinkado requires a deep soil with abundance of water, and the largest trees are consequently generally found along the banks of streams In the Pegu Circle it frequents either clay or loam. It is seen to greatest advantage in the Upper Chindwin Division on drained soil, near streams, the ground being apparently free from humus. It dies out in moist or badly drained areas. It is never found in evergreen jungle. In Lower Chinwin it grows in rich soil. In contrast to the last statement the Divisional Forest Officer, Pyinmana, reports that Pyinkado is good every-where where the soil is not too rich. It does not grow so large in South Tenasserim as further north. The greatest girth attained locally is nine to ten feet, but even this is most exceptional, as heart-rot usually sets in soon after six feet is passed. A tree of such girth would probably be 150 to 200 years old. The usual girth of Pyinkado in Pegu is eight to nine feet, but larger trees are occasionally met with. The height may be from 120 to 130 feet. In Pyinmana Division the dimensions of the larger trees are given at 120 feet in height and six feet in diameter, and the period in attaining such a size is recorded as 250 years. In Upper Chindwin good sized trees are from 45 to 65 feet high, some taller, and the girth of fine specimens is from eight to ten feet. The number of years it takes to reach this size is unknown, and it is probable that where these figures are given they are only to be regarded in most cases as approximate guesses.

Artificial propagation of Pyinkado has not yet been attempted in South Tenasserim and Pegu. It reproduces itself freely inside reserves and all over the Pyinmana sub-division in suitable localities.

A specimen of wood brought by Dr. Wallich from Tavoy in 1828 was so full of a red resin that it could be scraped off. The substance was partially soluble in hot water to which it imparted a reddish colour. The presence of this resin seems to be peculiar to the timber found in Burma, since the enquiry for this product of the trees all over India has produced only negative results. The Koyas and hill Reddies of the Eastern Ghats can give no information on the matter of the resin. This product is probably of the nature of kino, as it exudes in the hot weather in consequence of wounds made in the bark of the tree. It is produced in insignificant quantities in Burma, sometimes as the result of an accident, and is not collected for the purposes of sale or use. The natives in South Tenasserim call it *Thitsi*, which simply means wood oil, and is the name generally applied to the oil obtained from the *In* (Dipterocarpus tuberculatus). The tree is not known to be used for supporting the lac insect. The only information that could be gathered on this subject was a remark from the Conservator of Forests, Southern Circle, Central Provinces, to the effect that the young succulent branches were in certain places attacked by the insect.

The wood is hard, resinous and dark coloured and is highly appreciated in localities where it is to be had in fair abundance. "Neither the Teredo nor Termites will touch the heartwood." (Sir J. Hooker.) It is known as ironwood because of its weight, (60 to 86 lbs. a cubic foot). "A rifle shot at 20 yards distance will scarcely cause any penetration into it." (Colonel Blake.)

A relatively small amount of timber could be delivered at railway stations on the Burma State Railway at Rs. 4 or Rs. 5 per ton for short lengths. The bulk of the timber is, however, inaccessible owing to the want of roads. From the working-plans of the different reserves trees of six feet girth are estimated to be standing of about 1,000,000 tons. These, if they could be extracted, would yield from 30,000 to 40,000 tons a yard.

An indication of the actual outturn is afforded in the report on the Forest Department, Burma, for 1897-98, where it is stated that 25,851 tons (of 50 cubic feet) were supplied by this circle. The principal centres of supply were the Tharrawaddy and Bassein Divisions. The size of the logs that could be delivered would be limited entirely by the roads, but one-ton logs would present no great difficulty. Logs of any size or shape could be procured.

In Burma and Bengal, Pyinkado has been largely employed for making railway sleepers and telegraph posts. Between 1865 and 1868, inclusive, 70,377 sleepers were obtained by the East

Indian Railway Company from Arrakan. The Burma State Railway was laid with sleepers of this wood in 1877, and the majority of sleepers was still good in 1894. In 1876-77 Major Seaton reported that 10,000 sleepers from Arrakan sold in Calcutta at Rs. 5 each, while in 1884-85, 17,631 were sold there at Rs. 2-1 each. The cost of cutting and freight was said to have amounted to 12 annas per sleeper. In 1885-86, 81,569 sleepers were removed from Burma by Government Agency, of which 75,000 went to Madras and the remainder to Calcutta. The profit which accrued from the works in the Pegu Circle amounted to 36 per cent. A certain amount of scantling is also turned out of the mills in Pegu for building purposes and railway keys. Trees of 3 to 4 feet girth are used as house posts and bridge-piles. For these purposes it is said to be unequalled for its durability.

It has been found to be a most suitable wood for street paving, and one mill in Pegu is supplying planks 9 feet by 3 inches for paving blocks for England. In South Tenasserim and Pyinmana, the Burmans make house and bridge posts and oil presses from the wood, also harrow teeth and yokes for buffaloes. The hardness of the wood has been utilised by Mr. Oliver, Conservator of Forests, as a new form of boundary board. These are made of the wood, pointed at one end, so that they can be driven into trees of softer wood. The refuse of the sleeper works has been used for making tent pegs for the Rangoon Arsenal. Pegs to the number of 14,600 were supplied to the Arsenal during 1897-98 at a cost of Rs. 1,321, and the price realized for them was Rs. 1,752. Pegs of *gyo* (Schleichera trijuga) were tried, but were found inferior to pyinkado. No small or ornamental articles are made of this wood by the Burmans, except perhaps the Burmese bow. The timber has been used in the Madras Gun-carriage Factory for poles, axle-cases, and cheeks and axle-cases for lighter motar carts. Captain Puckle said that in 1862 it was used in Mysore for furniture, shafts, plough heads, knees, and crooked timber for shipbuilding. It has also been largely used for making charcoal for iron mines in Shimoga, Mysore.

A new interest during the past year or two has attached to the Pyinkado timber trade in consequence of the refuse of the sleeper-works in Burma having been found to be astringent and useful for leather manufacture. The *Indian Forester* for September, 1896, inserted the following letter from "H. S.," Bangkok, on the subject of "A New Source of Tannin."

"I last year forwarded to the Director of the Dehra Dun School a sample of a cutch looking substance which I asked him to kindly have analysed. I have just received his reply in which he says: "The Agricultural Chemist was good enough to examine the extract you sent, and reports that it contains 89·5 per cent. of tannins by Lowenthal's method. The extract was

obtained for me by Maung Kale, K. S. M. of Zigon, Burma, by boiling chips of Pyinkado in the same way that chips of cutch are boiled, but I have no information as to which part of the tree was used. Compared with cutch, which Watt says yields from 45 to 55 per cent. of tannin, the Pyinkado extract would appear exceedingly rich in tannin and worthy of further enquiry. Hundreds of tons of *Pyinkado* bark, and sawdust are annually carted away as refuse from the saw mills in Burma, and experiments might be carried out to see if tannin could be extracted from this waste product in paying quantities. I regret that my absence from Burma prevents me from personally prosecuting the enquiry."

The report of Professor Procter, Yorkshire College, Leeds proves that Pyinkado extract is rich in tannin, the colour is good, and it is a satisfactory tanning agent But with such a small yield of extractive matter in the wood, the question of making it at a profit turns on the cost of the sawdust. If the sawdust is really a waste product the manufacture might be attempted, but if any considerable value is attached to the raw article, the finished product is not likely to compete with ercognized trade articles. The Inspector-General of Forest has since written to say that the bark and sawdust are obtained in considerable quantity as a waste product of the saw mills, and that there would be no difficulty in making large quantities of the cutch-like extract.—(*Rangoon Gazette.*)

Forestry in the Bitish Isles.

In March 1899, before the Dublin Royal Society, Mr. Fisher, Professor of Forestry at Cooper's Hill, delivered an address on Forestry, the text of which is printed in the Proceedings of the Dublin RoyalSociety.* Discussing the question of forestry in a most practical manner, Mr. Fisher first sets forth the necessity of increasing the wooded area of the United Kingdom. He then goes on to point out the more apparent evils of forest management as at present practised in England, and the lines along which the working of the forests, whether as coppice, coppice with standards, or high forest, might be rendered remunerative. Finally he discusses the conditions of the existing forests in Ireland, and detals the areas which might be placed under forest. A map of the British Isles shows very clearly, for each country, the proportion of wooded and waste lands. The results are astounding. In a word, there are found to be 3 million acres of wooded areas, as compared with more man 28 million acres of waste and fallow lands, the latter

*Lecture on Forestry, given before the Royal Dublin Society, March 1899, by W. R. Fisher, B. A., Assistant Professor of Forestry, Royal Indian Engineering College. Williams and Norgate, 14, Henrietta-Street, Convent Garden, London. Price one shilling.

occupying more than one-third of the total area of the country. Moreover, the woods are chiefly treated as open parks and most grievously mismanaged. However, it is not only in England that private forests are thus managed in a happy-go lucky manner, the proprietors remaining in blissful ignorance as to the very existence of a sound, scientific system of management.

Ireland is extremely badly wooded. Compared with the other countries of Europe it has the smallest percentage of forest area. Mr. Fisher examines one by one the best known methods of forming artificial woods, especially in boggy soils; and he illustrates his remarks by reference to experiments which have actually been carried out in the country. He urges both the necessity of creating state forests in Ireland, to act as models ; and the giving of State aid, in the form of monetary advances, to private owners for the purpose of starting plantations, a form of land improvement. But in either case, trained and experienced foresters must necessarily be attached to the Agricultural Boards, as has already been done in the United States of America. In conclusion, Mr Fisher points out the advisability of giving instruction in Forestry at the Dublin University; and for this purpose a sufficiently large forest area would have to be acquired for practical instruction.

We are glad to find that Mr. Fisher still retains the fire of enthusiasm for forestry, which was first kindled in him at the Forest School of Nancy—a fact which his treatment of the subjects dealt with in his Lecture renders self-evident. The only regret we are feign to express is that the address has been published in English ; for this fact alone deprives many French Forest Officers of the pleasure a perusal of the work would have afforded them.—(*Revue des Rank et Forests*).

Trade in Dried Leaves and Flowers.

Mr. E. Rudowsky, Commission Agent, 14, Weinligstrasse, Dresden, Germany, asks us to draw the attention of our readers to the great possibilities there exist of opening up, between India and Europe, a remunerative trade in dried leaves and flowers, such as are extensively used in Europe for decorative purposes. Mr. E. Rudowsky, in his letter, states—"Our selection at the present time is very limited, and the steady growing demand in Europe compels us to seek for fresh fields to make up deficiencies, and as India has plenty to offer in that direction, there is a good way of opening new and profitable markets for such produce, and thus helping the Colony. To give you an idea of the possibilities of the trade, I will only mention that the so-called "Cape-flower," a small dried flower, is imported from South Africa in hundredweights and tons, and I do not see why similar results should not be achieved gradually from India as well. Articles of this kind should be gathered with about 3 to 4 inches stem, as the case may be, so as to fasten to wreaths, bouquets, &c., well dried and packed

in 10 lb. boxes (the limit the postal authorities carry), and sent by post. As they are light in weight a 10 lb. box would hold several thousands. Any dried leaves, flowers, &c. which are attractive enough to lend themselves for decorative purposes, would certainly be well appreciated here."

Mr. E. Rudowsky informs us that he will be glad to answer any further questions; to receive samples; and to give quotations. His address is given above.

Extraordinary Sprouting of Khair Posts.

Munshi Ahmed Mohiuddin, Ranger, H. H. Nizam's Dominions, sends us an interesting account of the sprouting of certain *khair* posts used in a building. "In a village near the Pakhal Reserve, Hyderabad," he writes, "there is a hut supported on khair (Acacia catechu), posts, which have sprouted and are now growing and bearing leaves. These posts were cut and brought from the forests about a year ago, in March or April; and the hut was built and completed *before the commencement* of the rains. The posts are from 10 to 12 inches in girth, and are imbedded in the ground to a depth of about 18 inches. The ground is well drained as the hut is used as a store-house for grains. This shows that khair, though a very hard wood, could be grown from cuttings."

Resistance of Seeds to High Temperatures.

M. V. Jodin states that seeds (peas and cress), when heated at once to 98°c. for 10 hours, are completely killed, but, when heated first to 60° for 24 hours, and then to 98° for 10 hours, a certain proportion (30 to 60 per cent.) retain their power of germination. Heated to 40° *in* sealed *tubes for* about 20 days, the same seeds entirely lose their power of germination; but this power was retained if a substance capable of absorbing water, like quicklime, was introduced into the tubes.—(*Journal of the Royal Microscopical Society.*)

Ascent of Sap.*

Mr. H. W. Chamberlain gives, in great detail, the results of a long series of experiments, on a variety of plants, on the phenomena connected with the ascending sap. Among the more important are the following:—After decapitation an efflux of water was detected in some plants, but not in others. Root pressure was stronger in herbaceous than in woody plants. The period of *the year has but little effect on the root pressure when the plant* is in active growth. As regards a daily periodicity, the plants under examination could be divided into 3 groups—in the first

*Bull. Lab. Bot. Univ. Geneve.

there was no trace of any daily periodicity in the flow of sap; in the second there was a daily periodicity, but the *times for the maxima and minima* were uncertain; in the third group the periodicity was regular and permanent. Variations in temperature (between 5° and 6°) had no considerable influence upon the root-pressure. Moistening *of the leaves greatly favours the ascent of sap*, while the saturation of the soil is very unfavourable. Succulent plants are characterised by a replacement of root-pressure by an energetic aspiration. The larger and more strongly developed the roots, the stronger is the root-pressure.—(*Journal of the Royal Microscopical Society.*)

Grafting of Monocotyledons on themselves

M. L. Daniel has been attempting for a long period, the hitherto unsolved problem of grafting a Monocotyledon on itself, and with a large amount of success in the cases of a species of *Vanilla*, and a species of *Philodendron*. The grafts are of the nature previously termed by the author "mixed grafts."—(*Journal of the Royal Microscopical Society*).

The Assimilation of Carbon by Plants.

A good deal of attention has of late been bestowed on the problem of assimilation of carbon by plants. In his presidential address to the Chemical Section of the British Association, Dr. Horace Brown described experiments which went to show that the surface of leaves absorbs carbonic acid from the atmosphere more than half as fast as would the surface if kept constantly wet with a strong solution of caustic alkali, and, as it is believed that the gas enters the leaves only through the stomata, the diffusion through them must evidently go on with great rapidity. Dr. Brown also discussed the utilization of solar energy by plants, and calculated that about 6·5 per cent. of the radiant energy of sunlight consists of rays that are absorbed by chlorophyll, and are therefore available for carbon assimilation. In this connection it may be noted that there is now a tendency to doubt the sufficiency of the chlorophyll theory, and some recent work points to the conclusion that green plants are able to assimilate complex carbon compounds directly through their roots.

On the industrial side the purification of acetylene appears to have been exercising a remarkable fascination on many workers. Installations of this gas have been erected in several cases as at Hawes and Filey, for lighting considerable areas, and in Germany it is coming into use for lighting railway stations, while in the carriages of the Prussian State railways it is employed mixed with oil gas. The number of places in the world where carbide is manufactured is now over 90, the increase being 82 per cent. during the year.—(*Times.*)

Fertilization of Flowers in New Zealand.

On page 16 of your issue of November 2nd. 1899, reference is made to an article in the London *Quarterly Review*, by "A Field Naturalist," in which the writer expresses the opinion that "under natural and equal conditions, self fertilization of flowers is both the legitimate fertilization and the most productive." I have not seen the article, but would like to place on record the following facts, which may be of interests to botanist in this connection:—

I have cultivated most of the common flowers of European and North temperate regions during the last thirty years, and have kept a pretty close record of their behaviour under the somewhat altered conditions in which they are placed in New Zealand. In this part of the Colony the climatic conditions are not very dissimilar to those of the milder and moister parts of Britain, but the insects are, of course, totally different.

Previous to 1885, when bumble-bees were first introduced into New Zealand, certain flowers which were freely cultivated here, never produced seeds under natural conditions. But since the bees have become numerous and have spread over the Colony, the conditions have quite changed. Primroses, cowslips and the various hardy hybrid primulas all seed freely. So do pansies, crocuses (except the common yellow Dutele, which does not seem to be fertilized by the bees), canterbury bells, antirrhinums, and many others which formerly never seeded. Now we find the plants in the spring-time surrounded by crowds of self sown seedlings.

The bees were introduced, as is well-known, by the Canterbury Acclimatisation Society, for the purpose of fertilizing the flowers of the common red clover—Trifolium pratense. It was supposed at the time, that the insect which was introduced was Bombus terrestris, which, by the way, is unable to fertilize the flowers of red clover on account of the shortness of the trunk. As a matter of fact, some of the nests brought out to the Colony were these of B. terrestris, but among them were also two varieties of B. hortorum, and it is this latter long-trunked species which is now so abundant, and fertilizes so many of the introduced flowers.

In spite of the fact that primroses and other flowers are now enabled to produce seed by the agency of the bees, attempts to introduce them into the woodlands and open spaces, and to get them to go wild there is still quite unsuccessful. Certain grasses, particularly cocksfoot—Poa annua and Poa pratensis—are too aggressive, and choke out nearly all other small vegetation.—(G. M. Thompson in *Nature.*)

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Grazing in Forest Land.

The *Revue des Eaux et Forêts*, of the 15th April last, contains a eulogistic article by Ch. F.akault, on a book on "Le Paturage en Forêt," by M. Alphonse Mathey, who, we believe, is not unknown to some of our readers.

The writer of the article has nothing but praise for M. Mathey's book, and a few extracts from it may not be without interest to Indian Foresters who have many difficulties to contend with in the matter of Forest Grazing. According to the writer the book gives evidence of exceptional scientific attainments on the part of the Author, who shows himself to be possessed of that experience in Forest matters which can only be gained by daily attention to all the important details of his work. M. Mathey, it is stated, shows a thorough knowledge of the requirements and laws which govern the life of plants, follows intelligently their developement, understanding how the herb and the tree together form the forest.

The writer, wishing to give a true idea of the value of the book which he affirms is throughout entirely worthy of praise, insists on the difficulty of his taste, everything being so carefully demonstrated, and the subjects dealt with being so numerous and varied that it is almost impossible to decide what to extract and what to pass over.

M. Mathey first conducts his readers to the *Landes*, which cover the lime-stone hills of Bourgogne, Lorraine and Comté of the Jura and of the Préalpes, the mountains of Savoy and the Dauphiné, the Morvan and the Cévennes. He shows what stores of latent energy Nature sets in motion, provided she is left undisturbed, and how the naked soil covers itself again with forests if not interfered with.

After studying the composition of the covering of the soil during the first stages of the formation of the forests, he explains how the vegetation in coppices and high forests is gradually

developed. In the case of the coppice he shows the necessary function of each member of the crop, from the inconspicuous moss hidden beneath the dead leaves, from the perishable herbs, the brambles and other shrubs, up to the most vigorous of the coppice shoots. Any hindrance to the spontaneous action of nature interferes with the regeneration.

Every leaf removed, every herb destroyed, impoverishes the forest, so that finally we arrive at the conclusion that "the removal of herbaceous growth from the forest is one of the poorest agricultural speculations imaginable." The cultivator, reduced to this expedient, is wasting his time, spoiling the forest and accumulating trouble for himself. Is it not the same in the case of high forest, whether of broad leaved species or conifers? A canopied forest offers but little in the way of grazing outside the glades and blanks, and as to conifer forests, subjected to the selection method—in every part of which regeneration is and ought to be going on constantly—grazing is quite out of the question. All the same it is tolerated almost everywhere. "It is a great pity to see the forest disappearing from such places where, of all others, it is most necessary."

These observations lead the author to establish the relation between the value of the pasturage and the forest revenue; his conclusions are not hopeful at a period when so many selfish interests are combined to bring about the ruin of our forests, and to despoil this source of national wealth. The injurious effects forest grazing are well known though perhaps no one has analyzed them with greater precision than M. Mathey. The trampling of the soil, the destruction of the underwood, the slow disappearance of the outer edges of the forests, the extention of blanks, are studied with careful precision. All these minute details are, moreover, of the greatest importance to the well-being of the forest. The trees from which the revenue is finally to be obtained are closely dependant on their surroundings, *viz.*, a loose soil, worked and cultivated by small animals which aerate it and bury the humus and organic remains, the undergrowth which protects the young shoots and seedlings forcing them upwards, the stunted, broken, deformed trees on the exposed outer limits of the forests, all are of the utmost importance. It is particularly necessary to protect this latter class of trees from damage by grazing, however useless they may be as timber trees. It is also certain that grazing induces cryptogamic diseases, thereby causing considerable deterioration in the value of the trees. If the few landed proprietors of our mountain districts allow themselves to be too often guided by the desire to enrich themselves at the expense of the public, and if a few of our national representatives knowing how to read and write yet feign ignorance of the fact that they are bringing about the ruin of the country.

The peasants of the plains at any rate are now beginning to agitate. The sound common sense of the French peasant, sharpened by a sense of his own interests, is now beginning to estimate, at their true value, the sophistries to which he has so long been accustomed. In all our provinces, even to Languedoc and Provence, private owners and those communes which are wisely administered, are beginning to utilize their waste land by planting trees. Their first care is to suppress grazing. They know, only too well, that their worst enemies are the grazier and his flocks.

As to forests kept for protective purposes only, however damaged and unpromising they may be, wherever there still remains some sign of life there is reason for hope. If the French people are but true to themselves, once the serious condition of affairs is realized, they will be ready to apply the necessary remedies to amend the evil. One of the most obvious and easily observable facts on the mountain regions of France is the steady disappearance of forest growth from the higher slopes, and the gradual destruction of the Alpine forests. The result of this is already being felt in many localities, and will soon assume the same alarming character elsewhere, totally destroying the agriculture of the high-level valleys.

" Above a certain elevation the soil is only capable of producing trees and herbage; of these two products the trees are the most important, in fact the economical exploitation of the Alpine Pastures is dependant on the proximity of fuel.

" In these cold regions man is absolutely dependant on a supply of wood being available, habitations keeping to the borders of the forests follow its downward movement, and the higher fields successively abandoned are left to nature or the depredations of goats and sheep. Numerous are the ruined huts, and yet more numerous the isolated farms left standing amidst the ruins of former prosperity. " Their incomes reduced and their expenses increased, many of these mountain proprietors have been obliged to seek the aid of public institutions.

Toward the upper limit of vegetation, bordering on the open pasture lands there extends a belt of open wood composed of larch, spruce and arolla. Tree growth there is sporadic, this wooded zone consisting below of groups of trees gradually thinning out above into scattered trees with short conical stems and a stunted growth, terminating finally in shrubs, and a bushy growth of green alder. During the last 9 or 10 centuries the forest zone has gradually retreated downwards some 1,000 feet, destroyed by man and over grazing, thus bringing about undesirable changes in the local climate.

" The disappearance of the forests causes a greater dryness of the air, and at the same time brings about a change in the nature of the atmospheric precipitations; heavy falls of hail take

the place of rain—these cut up the grass, carry away the soil and cause *sudden* and violent changes of temperature. At the limits of vegetation any injury to the sparse vegetation covering the soil is, as a rule irreparable, and such injuries therefore *tend to lead to the formation* of a mountain torrent. The present law which only allows intervention of the Forest Department in case of actual existing danger, is a detestable and ruinous law. *Under the terms of the* law of 1882 the State resembles a careless doctor who neglects a wound until the only remedy is amputation. While the Forest Department is busy re-stocking a few *small areas of mountain* land, the evil is gradually extending over 2 or 3 million acres; the graziers devoting all their energy and intelligence to keeping it constantly spreading.

For great evils severe remedies are necessary. The protective zone of forest is gradually disappearing in spite of the present legal restrictions; clear fellings should be absolutely prohibited in mountainous regions. They are simply disafforesta*tions* disguised. The state as an imperishable proprietor, can alone administer property which should remain intact as it ought to be administered. M. Mathey's concluding remarks are quoted :—" It is the same with forest grazing as with institutions which have played an important roll in the country for a long time, but which have been obliged to disappear with the progress of modern ideas. Indispensible to the requirements of the middle-ages, occasionally useful also in the century preceding our own, it has actually become a useless appendage to the proper working *of agricultural* methods. It is nothing more than an atrophied organ, which is not only no use to the organism but burdens and hampers it, and is the cause of numerous serious maladies on it."

The writer continues his article by a warm commendation of M. Mathey's work, the spirit in which it is undertaken and the scientific exactitude which characterizes it, remarking, that like *himself*, he must have sympathised with the unfortunate people whose properties he had seen destroyed and had witnessed the mournful exodus of the inhabitants of the higher valleys. For the last 20 years these experiences have been familiar to the writer during his tours through the mountainous districts of the south. From the Pyrennees to the Alps, in Provence, as in the Dauphiné and Savoy, the same desolation is met with.

He adds that the Swiss have furnished them with an example, for in that country the State and the Commune restrict the rights of individuals by preventing abusive exploitation in the interest of the public.

The cause of the forest has triumphed there, supported by Public opinion, enlightened by science and devotion to the Country's welfare.

M. *Flahault* concludes by expressing the hope that the coming century will see an increase of interest in the mountain

regions of France, and that it will be understood that there, as elsewhere, everything should be in its proper place, the forests in theirs, the fields below, and the grazing in some other place. Agriculture should be as intensive in the hills as in the plains and the present regime of communal pasturage is completely at variance with democratic principles. It injures the interests of the poorer classes for the benefit of a few rich and influential individuals.

Notes on Asaina.—(*Terminalia tomentosa*).

In the January number of the *Forester*, the N.-W P. and Oudh Forest Report for 1898-99 was reviewed. Reference was there made to certain remarks by the Conservator, Oudh Circle, on the reproduction of Asaina. These remarks the Conservator quoted from the Bahraich Divisional Report for the same year. As I wrote the latter, but have since come to a very different conclusion on the subject, I take this opportunity of correcting the original observation. Six months ago I had serious doubts as to its accuracy, and so have since then paid particular attention to the Asaina in my study of the Kheri Trans-Sarda Forests.

The original remark was to the effect that Asaina was springing up so abundantly in certain places as to retard the reproduction of Sal; that this was due to the earlier ripening of the seed of the former, and that fire-protection had thus favoured the Asaina at the expense of the Sal.

Briefly put my opinion is now the exact opposite, *viz.*, that fire-protection has not favoured the Asaina but the reverse, inasmuch as reproduction of the species is now at a standstill, and that the young growth now so conspicuous in places in the form of clumps of saplings, originated before fire-protection was started. How far this statement holds good for the tree as a whole in Northern India I cannot say. These notes are based on observations in Bahraich and Kheri only. The tree is common to many divisions, and I should be grateful to any Forest Officer who would publish his experiences of the tree, and thus direct attention to possible errors in these notes.

Taking the Bahraich Division first.—In the north part of Motipur, in Compartment 3 of Chakia, and near Ponsonbygang in Bhinga last year, I noticed patches of Asaina saplings coming up locally in old Sal forest. Saplings of the latter species were more or less absent, hence the remark in the annual report. Subsequently, when thinking over the matter, I could not recollect having seen any small seedlings of Asaina, although I remember that there were plenty of small ones of Sal. Mr. Hobart-Hampden has very kindly informed me that he has not been able to find any very small Asaina during the past few months. The average age of the saplings may be put at 15 years and upwards.

This coincides, I believe, with the time when these forests were first brought under fire-protection. It is instructive to note what Sir D. Brandis wrote* about Motipur in 1881.—

"In a large portion of this Forest, *viz.*, that which adjoins the Nepal boundary line, Asaina has the upper hand over Sal. The large trees are more numerous, and the ground is covered with a preponderating young growth of Asaina."

This was written three years after fire-protection was started there. Any one who is acquainted with the Forest will bear me out I believe in stating that this does not hold good now; that although Asaina saplings are often more numerous than Sal ones, yet the seedlings of the latter are making headway almost everywhere. Cutting back the Asaina would help on the Sal, but even without this assistance, given continued fire-protection, the latter will ultimately gain the upperhand. Exclusion of fire is of the first importance to the attainment of this end.

It may not be out of place for me to refer here to the remarks on the Asania contained in the Kheri Trans Sarda working plan of 1892. In paragraph 22 it is stated that:—

"The reproduction of Asaina is far inferior to that of Sal, and is absent from a large portion of the Forests. The damper portions contain a good many seedlings in belts and patches and in places they are met with growing side by side with sal seedlings."

It will thus be seen that my remarks are fully in accord with those of previous observers, so far as the main question of the scarcity of Asaina reproduction is concerned. Having had the advantage of seeing the Forests after 8 years more fire-protection, I merely wish to lay more emphasis on the fact. Over 30,000 acres of the Forest only came under protection in 1892, so that I fully believe that plenty of small Asaina seedlings were to be found then.

According to the date of commencement of fire-protection, the Kheri Forests may be grouped as follows:

Class	(*a*)	under protection since	1873.
,,	(*b*)	,, ,, ,,	1878 to 1880
,,	(*c*)	,, ,, ,,	1888
,,	(*d*)	,, ,, ,,	1892

Here and there all over the Forests Asaina trees of all sizes are to be found mixed with Sal. The distribution is not uniform, but this subject need not be considered here. Groups of trees under 1 feet 6 inches girth are also common to all the four classes of Forest, but whereas in classes (*c*) and (*d*,) the patches of young growth contain individuals of all sizes, from

*Suggestions regarding Forest Administration in N.-W P. and Oudh (para 81).

tiny stems no thicker than one's little finger up to saplings a foot or more in girth and 20 feet in height; in classes (c) and (b) seedlings under 6 inches girth and 10 feet in height are conspicuous by their absence. This generalization is based on my examination of the whole 75 compartments in the Forest. Unfortunately for the completeness of the observations, the Asaina loses its leaves in March and April, and I was unable to take up the detailed inspection of the Kadjaria Range in which the bulk of the classes (c) and (d) Forest lies, until within the past six weeks. It is quite possible, therefore, that I may have missed noticing young seedlings in Kanjaria. At the same time the dead leaves usually hang on for some months, and even now, at the end of May, the clumps of saplings thereby show up very conspicuously against the Sal. Local subordinates were no more successful than myself in finding small seedlings. The gang of men in Kanjaria engaged on working trees for fellings, after being on the look out for two days only succeeded in discovering one specimen. This was a small seedling with one green leaf, and the stem was rather swollen at the base. It was probably from 3 to 5 years old. Several of the smaller stems in one or two groups of saplings I partially dug up. Removal of the soil for a few inches was sufficient to show that the roots were much swollen and knotty. Just above ground one specimen was only 2 inches in girth, whilst just below ground it was 5½ inches round. A tall and vigorous sapling in the same clump, although 6 inches in girth at the base above ground, was only one inch more below ground. This points to the conclusion that all the individuals in a clump are of the same or nearly the same age.

The foregoing remarks, if correct, show that for all practical purposes Asaina reproduction is at a complete standstill in Kheri. I am at a loss for an explanation as to why this is so. That the occurrence of the phenomenon simultaneously with the progress of fire conservancy is more than an accidental coincidence I am quite convinced. This view I hope to corroborate further another year by looking at the adjoining Nepal Forests when the Asaina is in leaf. These Forests are burnt over annually, and if the above deduction is correct, it should be possible to find plenty of young seedlings.

The precise way in which fire protection (or any other cause) has operated to produce the above result is difficult to specify.

Increase of surface moisture would hardly have a prejudicial effect as the Asaina is more abundant in damp localities, and so, other things being equal, exclusion of fires should help to make other localities, formerly too dry more suitable for the species.

Diminution of the amount of light reaching the ground may be of more importance, although the existing clumps of saplings have for the most part come up under cover of older trees,

and very good poles are often to be found as single trees in dense Sal forest. It is rather rare to find the young growth of Asaina under old trees of the species ; as a rule, it is some distance away and under Sal.

The Asaina seed every year most prolifically. Experiment alone can show to what extent the seed is fertile, and what conditions are essential to germination.

It may perhaps be urged that although fire protection was only started some 27 years ago, there is nothing to show that the whole of the Forests were annually burnt before that time, and that the existing young growth has not come up in places which temporarily escaped being burnt. Having no records to fall back upon I cannot say. Probably one or two senior officers in the service who knew Kheri 20 or more years ago should throw some light on this point.

In conclusion I would remark that this subject of the reproduction of the Asaina is of some importance. The timber is saleable, and the bark may become more valuable in years to come. Although the inferiority of the tree to the Sal makes it neccessary to insist on the continuance of fire-protection where the latter predominates, or is likely to do so, it is quite possible that further knowledge of the habits of the Asaina may point to the advisability of discontinuing fire-protection where this tree forms the principal species ; that is on the assumption that the conclusions herein arrived at hold good in other divisions besides Kheri and Bahraich.

F. A. LEETE.

Liliaceæ in the Tons Valley, Jaunsar Forest Division, N.-W. P.

As I have found three species, all of the tribe TULIPEÆ, flowering low down in the Tons Valley, whereas they are given in Hooker's Flora as only occurring at higher elevations, I venture to put the fact on record.

Lilium Thomsonianum, Royle: (Syn. L. roseum, Wall.)—Hooker makes two species of these pink lilies, but remarks that Wallich was probably right in thinking them varieties of one. The specimens I found were flowering luxuriantly a little below 3,000 feet elevation in the Dharagadh, just below where the old Simla road crosses. This was on March 15th, 1900, but every thing was generally late this year, and they should be looked for in ordinary years at the end of February. They seem to be an intermediate form between Hooker L. Thomsonianum and L. roseum, and seem to support Wallich in classing them as one species. Hooker gives L. Thomsonianum as having stem 2-4 feet,

very many flowered and occurring at 5—7,000 feet, and L. roseum stem 12—20 inches, few flowered, a much smaller plant than L. Thomsonianum, and found at 6—10,000 feet. The Dharagadh flowers were 18-20 inches high, with 8 or 9 flowers on a stem, and were found at about 3,000 feet.

Gagea lutea, Schultz f.—Hooker gives this as occurring between 6,000 and 13,000 feet. It is common in the Tons Valley at 3,000 feet. This year it did not flower till nearly the middle of March, but last year it was out at the end of February.

Hooker gives 3-6 flowers, but I have found 1 or 2 to be the commonest in Jaunsar at all elevations, though I have found them with 6. This is the same with *Lilium po ypleyllum* Don. which I have often found with only one flower on a stem, though Hooker gives from 4 to 10. At the same time I have found various numbers up to 10, but have never met with this species at elevations lower than 6,000 feet given by Hooker.

Tulipa stellata, Hook.—Hooker gives the elevation where this is found as 5—8,000. This species is extremely common in the Tons Valley at 3,000 feet, occurring abundantly on wastelands between Tnadiar and the Dharagadh, but more luxuriantly in cultivated fields. It flowered last year at the end of February, but this year in the middle of March.

P. H. CLUTTERBUCK.

III.—OFFICIAL PAPERS & INTELLIGENCE.

The Lac Industry of Assam.

Mr. B. C. Basu of the Department of Agriculture, Assam,* has recently published a note on the Lac Industry of Assam. The total exports of lac from the Province for the last 5 years, 1894-1899, have averaged 17,905 maunds; and with the exception of a few maunds of manufactured lac exported now and again, the entire quantity of lac exported from Assam is in the shape of stick or crude lac. The bulk is shipped from the river ports in the Kamrup and Goalpara districts and is the produce partly of these two districts, and partly of the Garo and Khasi and Jaintia hills.

The principal lac producing trees in Assam are *Ficus cordifolia* (Assamese *Pakri* or *Jari*), *Ficus altissima* (Bengali *Kathali bat*, Assamese *Kanthalua bar*), *Cajanus indicus* (Bengali *Arhar*, Assamese *Arhar*, *Garo mah*, *Miri mah*), and *Zizyphus jujuba* (Bengali *Baer* or *Kul*, Assamese *Borri*). Lac also grows on several other species of *Ficus*, of which *Ficus religiosa* (Bengali *Aswathwa*, Assamese *Ahat*), *Ficus bengalensis* (the Banyan tree, Assamese *Bamuni bar* or *Brahma bar*), *Ficus elastica* (the India-rubber tree), and *Ficus infectoria* have been mentioned by name in some of the district reports. The two chief lac-yielding trees of Bengal, namely the *Palas* (*Butea frondosa*) and the *Kusum* (*Schleichera trijuga*), are little known in Assam. The former is mentioned among the lac-yielding trees of Sibsagar, and the latter among those of Cachar. Lac is also reported to occur on numerous other trees, including the following, of which the scientific names are known:—

Ricinus communis (castor oil).
Grewia laevigata.
Albizzia lucida (Assamese *Maj*).
Cedrela toona („ *Poma*).
Croton oblongifolius (Assamese *Mahudi*).
Glochidon sylhetensis („ *Panimudi*).
Artocarpus chaplasha („ *Sam*).
Ligustrum robustum („ *Bring*).
Terminalia citrina („ *Hilika*).
Bursera serrata (Garo *Thahrang*).

None of the district reports mention any difference in the quality of lac caused by the kind of tree on which it is grown. The distinction, so well recognised in Bengal, between the bright

*Note on Lac Industry of Assam, by B. C. Basu, Bulletin No. 6, Industrial series No. 1, Agricultural Department, Assam, 1900. Price 2 annas.

golden yellow lac of the *Kusum* tree, and the dull red coloured produce of the *Palas* is unknown in Assam. In Kamrup two kinds of stick-lac are recognised, *Tholoan* or plains lac and *Garoan* brought in by the Garos from the hills. The latter contains a smaller proportion of woody matter than the former, and, therefore, fetches a slightly better price.

The method of propagating lac in Assam is practically the same as in Bengal. There are usually two crops of lac in the year, one being collected in May and June, and the other in October and November. In Sylhet, the first is called the *Aus* or early crop, and the second the *Aman* or late crop. The first crop is mainly used for seed purposes; the second is the chief crop, and supplies the bulk of the exportable article. A few days after the harvest, pieces of stick-lac, containing living insects (*rahilaha*), are tied on to the branches of the trees on which the next crop is to be grown. The usual plan is to place the stick-lac into small bamboo baskets, and tie these on to the twigs of the trees. In a few days, the insects crawl out of the sticks, and spread over the young branches on which they at once begin to feed and secrete the resin. The secretion of lac is allowed to go on for about six months before it is gathered in. If sufficient lac has not been secreted, the insects are left undisturbed for another half-year. After the harvest, a fresh crop is immediately sown to be reaped six months later. It is said that a *Kathali but* tree (*Ficus altissima*) can grow lac for three or four years in succession, after which it requires rest. Some trees have been known to produce lac for ten or twelve years without rest. A good sized tree may yield from 30 seers to 2 maunds of stick-lac.

The lac insect does not thrive on *Ficus* trees which are of vigorous growth and contain an abundance of gum, and thrives best on trees of moderate vigour. The lac crop is liable to several kinds of pests, among which the most injurious are a species of ant, and the caterpillars of a tiny moth, both of which feed on and destroy the insect. The depredations of ants can be prevented to a certain extent by keeping the trunks of the trees clean, and by attracting the ants with jaggery and then destroying them with fire. Stormy weather, at the time when the young insects are spreading over the tree, may destroy them altogether.

Some additional particulars of interest, bearing on the cultivation of lac, have also been supplied by Mr. Dicks, Assistant Conservator of Forests, Garo Hills Division. He writes:—

"In March and April *Arohar* seeds are sown in the *jhums*, and in October and November, when the plants are 8 or 9 months old, the stem below the first branches are tied round with a few twigs, covered with seed-lac, *i. e.*, twigs containing the insects before the larvæ have escaped from the eggs. This seed lac is obtained from some one of the trees mentioned in the above list. When the larvæ issue from the egg, they ascend the stem up to

the young twigs, where they form fresh lac. This lac is harvested in March or April of the following year, by simply cutting the encrusted twigs. If, however, the crop of lac is not a good one, the lac-covered plants are allowed to stand over till October or November, during which time a second crop is formed. The *Arahar* plants are cut back after the harvest of lac has been collected, and, under favourable conditions, develop copious shoots on which another crop is raised the following year, but they never last more than two years.

"In the case of the other trees mentioned in the list, which are large trees, young poles, $2\frac{1}{2}$—4 feet girth, are selected, or, if larger, trees which branch near the ground for convenience in climbing. Bundles of twigs containing the seed-lac are obtained from the *Arahar* plants in March and April, and are tied round smaller branches of the trees. This crop is harvested in October and November by cutting the twigs covered with lac. Cultivation on such trees is carried on till they die or show signs of decay, but a year's rest is given to each tree after the collection of the crop to admit of the young shoots growing again.

"It thus appears that the seed lac is transported from the *Arahar* plants to the other trees and back again each year, and thus the supply is kept up. No care is bestowed on the protection of the insects on the trees."

Manufactured lac and the commercial product known as lac dye, are hardly, if at all, prepared in Assam now-a-days, and even the art of manufacturing lac-wares seems to be dying out, Sibsagar and Sylhet being the only two districts where the art is still practised. Wooden toys are the only wares ordinarily ornamented with lac in Assam, Sylhet town having once been noted for its lac toys, but these are now only made to order for export to Dacca and Calcutta. The woods used in making lac toys are—Panual (   ), Sam (*Artocarpus chaplasha*), Nabar (*Masua ferea*) Aghar (*Lagerstræmia flos-regina*), Jack (*Artocarpus integrifolia*) and Sonaru (*Cassia fistula*).

The composition of the lac-made colours used in Assam are described as follows:—

"In Sibsagar, the following colours are used. They are prepared by mixing shellac with the substances noted against them, respectively:—(1) yellow with orpiment, (2) red with vermilion, (3) blue with indigo, and (4) black with lamp-black or fine charcoal, obtained by burning the dry shell of a bottle-gourd (*Lagenaria vulgaris*). In Sylhet, a larger assortment of colours is in use. These are:—(1) sky blue (*asmani*), obtained by mixing powdered indigo and sulphur with shellac; (2) red, by mixing lac with vermilion; (3) violet, with violet powder; (4) grey, with white-lead; (5) brick red, with red resin; (6) orange, with vermilion and orpiment; (7) dark green, with green powder; (8)

green, with indigo and orpiment, (9) black; with lamp-black, and (10) yellow, with orpiment. The violet and green powders are presumably imported and of mineral origin. It is not known what red resin is."

There is nothing novel in the method of applying lac to wood as practised in Assam. It is only turned wooden articles to which lac can be conveniently applied. The article to be so treated is placed on the lathe, and while it is revolving, the part of it to which the ornamentation is to be applied, is heated and coloured by alternately pressing the end of a bamboo or rattan stick and a lac pencil of the desired colour against it. The heat, generated by friction with the former, causes the lac subsequently applied to partially melt and set itself upon the surface of the revolving article. The coating of lac is then smoothed over and polished by skilfully manipulating a leaf of *Kewa or Kaya kathal* over the revolving surface.

Lastly, it may be mentioned that the so-called black lacquer of Manipur is not a lac preparation, but is the juice of a tree known as *kheu* in Manipur. It is imported into Manipur from the Kubo Valley in Burma. The juice is extracted by making an incision in the tree. It is used in painting handles and cases of swords and knives, saddlery and leather works of all descriptions, gunstocks, etc. The Lushais are said to paint all gunstocks, and often gunbarrels, with this varnish. The *kheu* tree may by allied to the *Rhus vernicifera* of Japan, which yields the celebrated lacquer varnish of that country.

The best season for Coppice Fellings in Bombay.

Experiments have been carried out in certain districts of the Bombay Presidency, in order to determine the best season for carrying out coppice fellings. These tend to show that the months of September, October and November give the most favourable results; coppice stools cut in September and October will send up in four months shoots 2 to 5 feet high, whereas stools cut later seldom coppice before the next May. The following are the reports on this subject received from South and Central Thana :—

South Thana.

September and October, according to observation, seem to be the most favourable months to fell, so far as obtaining the largest coppice shoots is concerned, and the reason for this probably is that the absorptive power of the soil for nutrient substances is then at its maximum. The rains are not yet over, and the ground is strewn with branchwood and leaves, which give back considerable nourishment to the felled trees.

Teak coppice of September 1898 felling was found to be as much as 6 feet tall (maximum) by February 1899, *i. e.*, in 5 months. Whereas some trees cut in December, when most of the branchwood was removed from the coupes, were just beginning to sprout in February.

It is essential to have the coppice as tall and as vigorous as possible by February, as the heat in March-April is so intense that young shoots are then either killed or retarded in their growth. The earlier in the season the fellings are over the better it is in every respect for the growth in the coupes therefore from a sylvicultural point of view. We have it, on the authority of Hartig in fact that a cessation of vegetative activity takes place at the commencement of the dry period in the tropics resembling the approach of winter in the temperate zones.

Fortunately, it is not often in Thana that any heavy fellings are undertaken after the winter. Labour being cheaper earlier in the season most of the operations are carried out in September-October, but the trimming of the stools unfortunately is left till later on, in spite of orders to the contrary. Endeavours will be made to enforce the latter operation simultaneously with the felling, but it is difficult to do so, as ordering and performing are two different things in a large District like this.

The apparent sterility of many older stools is, it is thought, attributable to this late trimming. The trees are cut and the stools left untrimmed, and probably have coppiced. Later on in January or February they commenced to be trimmed, and the previous coppice is cut back never to shoot up again owing to cessation of vegetative activity due to the intense heat.

Close observations were made during the year as to the best method of cutting and trimming the stools of trees for coppicing, but it is too early yet to record the results of these observations. Further notes will be taken during the ensuing season, and information on the subject will, it is hoped, be given in the next Annual Report.

Central Thana.

Reproduction by coppice shoots varied, according to the time of year in which the trees were felled. From observations made during the last two seasons, I have come to the conclusion that the months September, October and November are the best months during which to cut teak trees in order to get the best coppice shoots. Teak trees cut during these months have thrown off, by the month of March, coppice shoots from 3 to 5 feet in height, and in very favourable places even better shoots are to be found. On the other hand, teak trees cut in February and March fail, in the larger number of cases, to throw off shoots at all during the first seasons after being felled.

From September to November is also the best time to cut the teak, from a contractor's point of view. At this time when a tree is felled the bark can be easily stripped from the log, and there is also less danger from the log cracking whilst being seasoned.

It thus happens that the most advantageous time for felling, to the two parties concerned, *viz.*, Forest Department and timber contractor, is one and the same.

The Treatment of Grass Land.

Experiments have been carried out in Berar by the Forest Department to determine the relative yield of dry fodder per acre from (1) areas annually burnt over, (2) areas burnt over and subsequently grazed over, and (3) areas neither grazed nor burnt. The results obtained are reported on as follows, by the Conservator of Forests, Hyderabad Assigned Districts :—

"The experiments regarding the treatment of fodder grass areas in Amraoti were continued with the following results:—

Plot (B State-forest).	Out-turn of dry fodder, in pounds, per acre.						
	1893.	1894.	1895.	1896.	1897.	1898.	Average last five years.
I—In the area burnt ...	2,736	2,501	1,091	739	2,558	2,850	1,948
II—In the area grazed	2,668	2,338	1,223	988	1,619	2,702	1,834
III—In the area cut over and neither grazed or burnt. ...	2,386	2,417	1,228	755	1,825	2,268	1,703
Average ...	2,597	2,419	1,181	834	2,101	2,607	1,828

"The experiments have been carried on over five years of varying rainfall and growth, and will now be discontinued. They tend to prove that burning gives the highest yield, but that grazing down the stubbles (without, of course, injuring the roots by excessive trampling) gives a fair average yield. In Berar sufficient grazing is accordingly being tried in "ramnas" that lend themselves to this treatment."

These experiments merely relate to quantities of fodder produced. No account is taken of the quality of the grass, and it is a pity this question was not dealt with in carrying out the

above experiments. There is a widespread notion in India, that burning of grass lands is necessary, in order to improve the grazing. This, however, it does not do, as has been conclusively proved in Madras. In reality, by firing the grass, most of the delicate annuals, such as *Panicum Oplismenus, Isachne, Poa, Eragrostis*, etc., which are especially good for cattle, are destroyed, while the coarser kinds, such as *Andropogon nardus* and *Schœnanthus, Apluda aristata, Chrysopagon sp., sp., Imperata arundinacea* and *Anthistiria ciliata*, which are not so good for fodder, and of which only the young shoots are eaten, are encouraged. We should be glad to see some experiments carried out on these lines in Berar.

The Poona School of Forestry.

The Progress Report of the Poona School of Forestry, for the year 1898-99, is reviewed by the Conservator of Forests, Central Circle, Bombay, in the following terms :—

" The Professor of Forestry at the Poona College of Science reports that the progress in the Forest lectures has been normal, and, judging by examination results, the students are slightly below the average as regards their intellectual abilities.

" On the 1st July 1898, there were five students in the Forester Class; four of these had previously failed in the Final Examination held in January 1898 ; one qualified by a narrow margin at the Final Examination held in January 1899. These men all had a very superficial knowledge of English, and were the dregs of the Workshop Class not considered good enough for the Sub-Overseer Class. There is no Forester Class this year.

" *Senior Ranger Class,*—On the 1st July 1898, comprised 17 members, of whom two failed to appear for their Final Examination, but the numbers were made up by two students who had previously failed; out of the 17 examined, 10 passed the examination.

" *Present Senior Ranger Class,*—On the 1st July 1898, comprised 9 students (1 from Travancore State); of these, 8 joined the Professor on tour. The number is now, 30th June 1899, 12 by the addition of students who had previously failed. All these will probably go in for their Examination.

" *Present Junior Ranger Class.*—Some 37 students appeared for the Scholarship Examination in January 1899. Of these about 36 remained, but partly on account of plague and partly because of other reasons, the number at the beginning of the second term was 24, and on the 30th June 1899 but 22 (of whom 4 are Native State, Travancore, students)."

The Forests of Western Australia.

The Forests of Western Australia and their development, with Plan and Illustrations by J. Ednie Brown, Conservator of Forests for Western Australia, Perth.

The above is a new and enlarged edition of Mr. Ednie Brown's "Report on the Forests of Western Australia," originally issued in 1896, and long since out of print. Considerable corrections and additions have been made "so as to make the report an up-to-date compendium upon the Forests of Western Australia, and of the various conditions which now surround their utilisation and administration."

The Flora of this division of the Australian Continent is a very large and unique one, and contains a very considerable number of genera and species of trees; but of these a few only are at present known to be of any real commercial value. There is perhaps none of the Colonies which has a greater number of

Acacias than does this one, but the principal trees belong chiefly to the Eucalyptus family, many of which are second to none as regards worth and durability of their timbers; and three of these the Jarrah (Eucalyptus marginata), the Karri (E. diversicolor) and the Red Gum (E. calophylla) have attained such world-wide reputation that within the last three years, the Colony, from an indefinite and comparatively little-known market, has bounded into a leader of export timber-trade with most parts of the world. The distinctive feature of the forests of Western Australia, and one of the points of strength in the disposal of her timbers lies in the fact that the timber trees are chiefly gregarious. As Mr. Brown points out this is, fortunately, particularly the case with the two principal members, Jarrah and Karri, although, as a rule, the former is always found forming a sort of fringe to the latter, but *never the latter to the former*. This fact enables the Conservator of Forests for Western Australia to prepare, with comparative ease, an interesting coloured map of the Colony, showing the distribution of the principal timber trees; and the areas respectively occupied by these have been estimated by him as follows:—

	Acres.
Jarrah, chiefly, (with Black butt and Red gum)...	8,000,000
Karri	1,200,000
Tuart	200,000
Wandoo	7,000,000
Sandalwood, York gum, Yate and Jam ...	4,000,000
Total area of the principal forest surface of Western Australia	20,400,000

Moreover, Valuation Surveys give the following estimates of the *matured* timber at present growing in the forests of the colony:—

	Loads.
Jarrah	*40,000,000*
Karri	15,000,000
Tuart	300,000
Wandoo, Yok gum, Yato, Blackbutt ...	7,000,000
Estimated total loads of round matured timber* now in the Forests of Western Australia ...	62,300,000

This immense quantity, which is believed to be considerably under what actually exists, is worth, after making all possible deductions, no less a sum than, in round numbers, £124,000,000.

*These figures do not refer in any way to the permanent value of the forests, but only to the crop of trees which is now available for utilisation.

Notwithstanding the existence of all this wealth of timber, growing on unencumbered crown lands, there are no Government Forests as such. Systematic forest management is non-existant. No provisions to speak of are made for the future, and the forests are being worked in accordance with no well-considered plans of operation. It may be true that the considerable cutting and removal of the timber (estimated at 322,000 loads per annum, representing a gross value of £ 2,000,000), which has already been done is infinitesimal compared with the enormous quantity involved, yet the end must surely come, unless immediate action be taken to set apart portions of the timber areas as "*state forests*" and timber reserves, to be worked under a defined system of conservation. To let the matter stand over for a time means loss of country only suitable for forest purposes, a deterioration of supply, loss of legitimate revenue, and an increased liability in regard to rectifying rights and privileges which may be incurred meanwhile. Whereas, if dealt with now in an enlightened manner, the forests of the Colony have a bright future before them, and will become a lasting revenue-producing asset of the State.

As it is, the "Department of Woods and Forests," not having any Government Forests to manage as such, devotes itself to seeing, as far as this is possible, that the holders of the special timber concessions and timber leases do not aimlessly and wilfully destroy the forests. Theoretically, lessees are required to limit their cuttings to trees above certain diameter for each species. Care must be taken to protect seedlings and saplings. Licenses must be procured by every one working in the forests. Sawmills of a specified capacity must be erected and kept in good working order. The cutting of poles is allowed only as necessary thinning to the forest, and an officer points out how this thinning should be done. Failure to adhere to these directions may involve the forfeiture of the lease: but with this condition, "Timber leases" may be had on application, at the rate of £ 40 per square mile per annum, for a term not less than one year, and not exceeding 25 years, and no lease shall include an area of more than 75,000 acres.

The one redeeming feature in the present position of forestry in Western Australia appears to lie in the fact that considerable agitation has been started in order to put matters on a sounder basis. And, indeed, in this respect, the Conservator, Mr. Ednie-Brown, deserves the greatest credit. In his book Mr. Ednie-Brown lays great stress upon the necessities of the moment, and these he sets out in clear and unmistakable terms, which we trust will bear fruit. Those of our readers who may be contemplating a trip to Australia are not likely to forego a visit to the magnificent forests of Western Australia; and to these a copy of Mr. Brown's book is indispensible. It contains, moreover, a series of very beautiful pictures from photos taken in the forests.

V.–SHIKAR AND TRAVEL, &C.

Tiger Shooting in the Malni Forests, C. P.

At the foot of the Satpuras, not far from the mountain homes of Mahadeo, lies the Malni Forest Reserve. In the good old days, to the keen shikari, there could have been no fairer country, both for scenery, climate and "sport." In those days, the Malni Reserve lay on the borders of an interminable expanse of forest-country, open and park-like, crossed by many small streams, running swiftly in their rocky beds. Low hills, covered with a pleasing mixture of teak and large feathery bambus, were dotted about at frequent intervals, and in the near distance range upon range of mountains rose high, one above the other. In all this vast extent of country there were but few small scattered villages; but, on the other hand, it was the home of the aboriginal gond, a race which, alas, is fast disappearing with the advance of cultivation and so-called civilization; and it has already lost, at least in those parts, all its manly, noble characteristics. In those days every man could have prided himself on being a simple, truthful, unsophisticated man of the woods, a true lover of the jungle, a real sportsman. In addition, each village had its recognized shikari, or leader of the hunt: but the leader of them all, the recognized and accepted king, was Telu. He was, perhaps, the last of the real unadulterated aboriginal gonds of the old school. A born shikari, a perfect tracker, a polished jungle gentleman. He was long, lanky and venerable in appearance. Clothed in his black, wrinkled, epidermis; a piece of string round his waist; a "chakwak" (pipe) worn behind the ear; with his long flowing matted locks—nothing could ruffle his temper, or his keenness after shikar. Alas, poor man, he died, so the legend goes, many years ago, a victim to the ire of the Deo, over some little neglected shikar offering.

The gonds, however, did not hold undisturbed possession of these wilds. There were many other denizens of the jungle; and the bison, the sambhar the cheetal, the smaller deer, the black bear, the tiger and the panther were all to be found here. My first year in India was drawing to a close when I found myself posted to the Malni Reserve. During the whole of the year, my one and only ambition had been to shoot a tiger: and in the vain endeavour to get one I had tried every expedient that mortal youth could dream of—stalking, beating, bribing,

praying, cursing, sitting up by day and by night, everything had been tried in vain. I had in fact begun to think that tigers were a fraud and a dillusion, except as regards their pug-marks. But the Malni Reserve soon raised my hopes. Not only were pug-marks plentiful enough, but my gond friends, who had got over their natural shyness, and with whom I very soon got on the best of terms, assured me of easy success, and told me many a startling tale. Not only this, but the good sport I had with other beasts—my first sambhar, my two bears, my panther—soon raised my fallen hopes.

It was under these circumstances that Telu and the little band of shikaris I had collected together, came to me one day with the news that a tiger was creating much havoc among the cattle at the village of Malni, which gave its name to the Reserve; and they urged me to proceed to the place as soon as possible. Accordingly, Telu and his little court, with a herd of young buffaloes, went on a-head to prepare the way, and I myself soon followed.

In those days, Malni was a small gond village, though perhaps larger than most, situated some short distance from the river of that name; and the strip of broken ground between the village and the river was covered with scrub jungle, fairly dense in places, with a few large trees; the whole intersected by numerous small, moist, shady streamlets and nalas. On arrival the reports I received were so excellent that I soon determined to get that tiger, and I am afraid it would have required many, very many, reminders from my superior officer before I could have been got to budge. Moreover, postal arrangments were very defective. However, the luck was with us, for the very first morning after my arrival Telu came rushing into camp with the news that one of the young buffaloes had been killed during the night, and its carcass dragged away into the jungle—always a most auspicious sign. Messengers were immediately sent off to bring up as many beaters as they could from the surrounding scattered small villages. Meanwhile, Telu and myself did a track round the area in which the tiger was supposed to be slumbering after its gorge. The tiger had killed in the patch of jungle between the village and the river, and so the matter was comparatively easy. The River Malni on one side, the village and fields on the other, and a nice sandy path above and below; and the results of our investigations were most satisfactory. The tiger was there, so Telu assured me.

The next operation was the tying up of the machan, and more particularly chosing the right tree to have it on. Personally, I knew nothing about it, and so had to trust to Telu; and we chose a spot with a small open space in front, and a small strip of growth on the left.

Eventually the beaters arrived. I was seated on my tree, the stops were duly arranged on the right and left of me, and the beat began. For volume of noise, mingled with queer weird vocal sounds, the beating of the tom-tom and the ubiquitious kerosine tin, it would be impossible to beat a throng of aboriginal gonds. And so the beat came merily along, and I was ready to jump out of my skin with very excitement. Suddenly a grunt and a growl was heard—and then a huge beast is seen by me to be moving through the patch of scrub, away on my left, some 200 yards away. At the same time, the group of stops on my left start coughing and hammering.

Mad with excitement I loose off my rifle in the direction of the tigress. Bang goes my right barrel, bang the left; and by the time the smoke has cleared away there is no sign left of the tigress. However, no sooner have I had time to reload my rifle, than the tigress appears in the open, straight in front of me. She is apparently looking straight at me, and about 80 yards away. This is too much for me, and whizz goes the bullet from the right-hand barrel. Over rolls the tigress, kicking like a shot rabbit, and bang goes the second bullet, and the smoke clears away for me to see the tigress bolting back towards the beaters. Much excited, I had hardly time to reload when away on my right, across the open space, a small young tiger dashes past and then a second. I at once imagine that they must have stopped on the edge of the jungle, and to get a better view I proceed to scramble higher up the tree. As I am scrambling up out dashes a third young brute and stops immediately under my tree. Balancing myself as best I could, I fire, only to see the cub dash on into the jungle.

Eventually the beaters come up; I descend from my machan, and a consultation is held. There is no doubt that the tigress is badly wounded—a pool of blood where she fell, and blood clearly shows the direction she has taken. But, alas, the three cubs have gone off unscathed.

In the excitement of the moment I at once determined to track the wounded tigress, and away we start, the plucky gonds only too keen to follow. The blood, however, soon stops, and matters are proceeding somewhat unsatisfactorily, when one of the shikaris suggests that the tigress must have made for water, and he assures us (as far as I am able to understand), that he can take us to the very spot. Accordingly, we give up tracking and proceed straight for the suggested haven of rest. As we get near the spot, men climb up trees to look ahead, while the rest wander about somewhat aimlessly. Suddenly one of the men from the top of a tree remarks, in a very casual tone of voice—"There lies the tiger." Immediately we all come rushing up, convinced that we should see the fallen monarch dead as mutton,

We are all crowding round a little bush growing out of a small nalla, when suddenly a terrorizing "uph-uph" resounds at our very feet, and out springs the tigress. We did not stop to inquire, away we scattered in all directions and scrambled up the nearest trees; whilst the tigress fortunately for us, kept to the nalla and disappeared. That was enough for me, at least for that evening Besides, it was getting dark. And so we wended our weary way home, sick at heart that no trophy had been bagged. However, we were soon holding councils of war; and the valiant Telu's proposals that a company of buffaloes should be brought in to our assistance next day were unanimously carried, and all arrangements duly completed. Meanwhile, I spent a restless night, dreaming of tigers and cursing my bad luck.

Next day the beaters and a herd of buffaloes arrived, and away we started. All Central Indian sportsmen will have learnt the value of the jungle-reared buffalo in tracking wounded carnivora. Accustomed, as they are, to live in the densest jungle, they are quite prepared to meet the onslaughts of any tiger, and promptly forming into line, heads down, they will charge straight at any tiger they may meet. Accordingly, on this particular morning, it was decided that I should sit on a selected tree and that the beaters should drive the buffaloes through the jungle, and thus beat the wounded animal out. I had not sat up very long, and the comparatively silent beat had only been going on for a very short time, when away, in the distance, down below me, some considerable distance away, I saw a huge tiger bound across a small open space. I at once got to the ready and waited patiently, shortly to be rewarded by the tiger appearing; and there he stood, a few yards from me, looking back in the direction of the beaters; but alas his body was covered by a clump of trees, on one side his huge head projected, on the other his tail. No, it was impossible to fire, and meanwhile I shook with excitement and fear that the tiger would see me and bolt. However, after an age of suspense, the tiger stepped forward quietly and slowly, and his body being exposed I fired. Down he dropped without a move, save a wag or two of his tail. But I was not going to lose him this time, and before he could ever think of coming to life again, three more bullets were duly lodged into him.

Soon the beaters came up and there were great rejoicings: but this was not the wounded tigress. It was a fine male, 10 feet 5 inches, and never a wound had he received before. The question of the wounded tigress, therefore, still remained to be solved. Accordingly, we proceeded to track through the jungle, the shikaris leading the way, tracking down the dry nalla beds, the buffaloes being driven through the thicker bits of jungle. After a time we came to a small underground nalla, a kind of a small winding cave, which opened out into the bigger nalla down which we had been tracking. The trackers stopped, and

after some little further examination arrived at the conclusion that the wounded tigress had retired into the little cave. But there were doubts expressed, and so in the hopes of further developments arising I took up a position behind a tree at some little distance from the mouth of the cavern and fired a charge of shot into it. At once a deep, low, growl came out from the cave, and away every one fled to take refuge up the nearest trees, whilst I stood at attention. But nothing further happened and similar charges of shot only succeeded in bringing forth low grumbling growls. Consequently, other steps had to be taken. On creeping up to the mouth of the hole and cautiously peering in, it was impossible to see anything of our friend, as the small cave at once wound round to the right. It was, therefore decided to try the effects of a prog. Accordingly, I stood at attention on the banks of the nalla just over the hole, whilst two of the braver gonds, armed with a long bambu, proceeded to push this into the hole. Suddenly, a loud roar. Away they all bolted, fully expecting that the tigress would bound out in her wrath; but no tiger appeared. Again and again were those tactics followed; but save for a growl there was no apparent result. Braver and braver grew the proggers, and the tigress, in her anger, would gnaw the end of the bambu but she refused to show herself. Owing to the winding nature of the hole it was impossible to get at her, and so the bambu was given up in despair. During these antics we had noticed that a small tiny crack in the ground led down from the bank into the hole, and peering down it, a small portion of the tigress could be seen. In fact, its tail, as it afterwards turned out. Accordingly, I had sent for kerosine, but only a single bottle was forthcoming. This we lighted and poured down the whole, with the result that the tigress' tail was badly singed: but still she refused to show herself. And so the day passed and darkness was coming on, so that all further plans of operation had to be postponed. Moreover, the shikaris assured me that the tigress must be at the point of death, otherwise she would never have endured such treatment. We contented ourselves, therefore, with blocking up the mouth of the cave loosely with branches, and then wended our way home, fully confident that next day we would merely have to dig her out. And all arrangements were made to obtain the necessary implements from a distant depôt.

Next morning, armed with spades and pickaxes, we again set out: but as soon as we reached the hole, the shikaris, after examining the place, pulled out a few hairs and exclaimed, "The tigress has got out during the night;" and sure enough there were the pugmarks going down the nalla towards the Malni River. Here was a serious predicament. A council of war was hastily summoned, and as a result the buffaloes were again sent for, whilst we waited in patience. After a few hours the buffaloes

arrived, and the order for an advance was given. The shikaris and myself tracked down the nalla, the buffaloes were driven through the jungle on either bank, followed by the beaters. And so we tracked down the nalla, until we came to the river, where it was found that the tigress had turned back into a dense bit of jungle a little higher up. But she had not drunk water in the river, and this was considered a good sign by the shikaris, who took it to mean that she must indeed have been very bad. On the edge of the river we again formed up into line, the buffaloes on this occasion leading, and we all followed. Suddenly, after having proceded a short distance, the buffaloes made a mad dash forward, snorting vigorously; something yellow was seen to dash past in front of the buffaloes and jump down into a *small nalla a little to our left, whilst all the beaters and shikaris* disappeared up trees. Meanwhile, goaded on by my friends, who were safely ensconced on the tops of trees, I crept quietly up to the edge of the nalla and peered over. There, round the nearest bend of the nalla, I could just make out the tigress' tail, and little else; however, I came to the present, and taking careful aim at the root thereof, discharged both barrels in rapid succession, and then gracefully retired at the double. After a short time, having reloaded, I again advanced cautiously at the ready, but just as I crept up to the edge of the nalla and peered over, there was the tigress a couple of yards off, staring me in the face, and she at once opened her mouth, making a hideous face; but like a flash of lightening I fired and the tigress sprang a few feet into the air, and *fell on the same spot; again I fired and over she fell.* But my blood was up; hastily reloading, I fired again and again, and assurance was indeed made doubly sure. It was now getting dark, so the tigress was hastily swung on to a pole, flaming torches were lighted, and our entry into camp was indeed a sight for the gods. My first tiger, and a tigress besides, and no end of a tamasha! On the first day the tigress had been hit a little to the right side of her chest, and it had all festered very badly.

And now for the moral. When I began writing this account of how I shot my first tiger, I had certainly meant to draw a moral for the benefit of our young shikaris. I should have felt that I had not written in vain if I could impress upon them the folly of at once following up a wounded tiger on foot; the *folly of losing one's head and firing* at a dangerous animal at long ranges, especially when it is coming straight towards one; the folly of ruining a valuable skin by firing a quantity of lead into the carcass of the dead animal. But after all, does my story really bear out these excellent precepts? Had I followed them, how much never-to-be-forgotten excitement should I not have missed? And apparently, as long as the luck is with one and the gods are favourable, *all will end well After all,* youth may indeed rush in where extension-wallahs fear to tread.

FELIS CHAUS.

Goat Killed by a Porcupine.

On the night of the 26th instant I had some goats tied up along a nullah near my camp as bait for a panther.

Next morning I found that one of them had been killed by a porcupine, evidently early in the night, for the body was stiff and cold. One large quill had pierced the heart, and remained there, whilst another was imbedded in the stomach. Three smaller quills were lying on the ground close by. The foot-marks showed that the porcupine had made a rush at the goat, but whether it had purposely attacked it or not, it is impossible to say.—(*R. G. Burton in the Journal, Bombay Natural History Society.*)

VI.—EXTRACTS, NOTES AND QUERIES

The Forest Department Indicted.

The *English Mail* and *Indian Engineering* have both been having a free kick at the unfortunate Forest Department, but neither of the free kickers would remain five minutes in any County Fifteen. The London Correspondent of the *English Mail* under date of May 6th, writes as follows:—

"The Council of the British Association have, I hear, brought under the notice of the Secretary of State for India the deficiency in botanical knowledge of the officers in the Forest Department of India. It is submitted that they ought to possess scientific knowledge to seize opportunities of extending the resources and developing the economic value of the great Indian forests, and which would give them power to deal with plant diseases. It appears that with few exceptions the forest officers on actual duty have at most a very slender equipment of botanical knowledge. The Council point out that this undesirable state of things is in a great measure due to the fact that the mode of selection adopted is not such as to draw into the Indian Forest service men whose aptitudes and tastes fit them for their future duties. The work of a forest officer calls especially for those powers of observation and inference which natural history studies are preculiarly fitted to encourage. The Council advocate that a scheme of examination should be framed which would at least tend to the selection of men of scientific aptitude to fill the offices in question. *The fact is that Indian forestry is neglected just as English forestry is ignored. The little training school at Cooper's Hill is excellent in its way, but it is necessarily a limited affair*, and is simply a department of the work of the College."

We have not been favoured with a copy of the report of the Council of the British Association, and we should like to

know on whose authority it is alleged that "the Forest Officers on actual duty have at most a very slender equipment of botanical knowledge." We may console ourselves to some extent with the inference that the Forest Officers on leave, or retired, make up the deficiency, so long as they are not on actual duty. Now, Forest Officers, whether on actual duty or not, may be divided into 3 classes—(1) those without any training whatever, (2) those trained in France and Germany, (3) those trained at Coopers Hill. Of class (1) nothing is expected. Class (2) has never been found wanting, and has produced some botanists of considerable attainments, one of them even carrying the Colours of the Department into the Royal Society. But the charge seems to refer chiefly to class (3), which is attacked on two sides. On the one hand it is alleged that the recruits are not of the right class, on the other, that the training is improper. "Class," here no doubt refers not to the social standing of the recruits (which is much the same as that of the Indian Civil and other Services), but to their age and attainments. A man who goes up for Coopers Hill at 18 years of age has to ask what are the paying subjects for the entrance examination. Botany is not one of them, and equally probably it is not a science in which he has done much at school. A man who goes up from a public school or university at 21 years of age may be strong in Mathematics, *Latin, French, German, Botany, Chemistry, Dancing* and Singing, and so fitted to pursue a meteoric course through any Civil Department in India. So much for class, now for the training. It may at the outset be admitted that the Foresters went originally to Coopers Hill rather to bolster up that excellent Institution than to better the continental training; and it is quite true that they are now a very small fraction of the College. The training may perhaps be too much on engineering lines as a whole, but the Forestry teaching has been the best obtainable in England and the Botany teaching was that of Marshall Ward, which means *that it could not be bettered anywhere. Least of all could it be* bettered by substituting a dry-as-dust species-monger in the professorial chair. The Forestry teaching might no doubt be considerably improved, for 9 months of counting fuel stacks, and "doing chores," as our American cousins elegantly put it, in a small German Division, and followed by a 3 months traveling picnic, can hardly be considered the very best and completest forest education.

There is another very important point which should be altered, for at present the Forest Department simply gets the dregs of the Police. The entrance examination for *Police and Forests* being combined, all the best men naturally elect for the former, since they come out at once on the same salary, and are provided for without the trouble and expense of going through 3 years' training.

The remaining important point in "training" concerns discipline, of which there appears to have been some lack at Cooper's Hil, and without a firm Head, no system of education can be efficient.

Indian Engineering of May 19th expresses the following views, which are like the Bishop's eggs :—' Excellent in parts," though there are portions of them which disagree with us in the same manner as the other "parts" of the egg disagreed with the curate. The following are the views :—

"Instead of developing such fads as Forest Mathematics and Forest Engineering, it would be more beneficial to the Country and profitable to the State if Forest Officers devoted more attention to Economic Botany and Practical Entomology. The work of a Forest Officer calls especially for those powers of observation and inference which natural history studies are peculiarly fitted to encourage. The Council of the British Association have noted the deficiency, and have made a public remonstrance on the subject."

The portion about the "work of a Forest Officer" is one of the "parts" that agrees with us, and indeed, *exempli gratia*, our natural history or other studies enable us to make a few "observations" on the above quotation. We shall strictly abstain from drawing any "inference" on the principle *de mortuis*, &c.

Our Contemporary says that "*Forest Mathematics*" and "*Forest Engineering*" are fads. Our Contemporary no doubt means well, but is unaware that "*Forest Mathematics*" is no new-fangled invention. There is in Germany a fairly portly volume of respectable age. It is called "Forest Mathematik," and is considered to be no mean authority on certain points. The man who had the misfortune to write it, and so become a faddist, was in his day looked upon as an intellect whose abnormality was not that of the "harmless lunatic" kind. Poor man, how times change, *et nos mutamur in illis*, and our opinions too. Yet it seems possible that when a student goes through a two-years professional course, there may be some soundness in the idea of collecting together all the mathematics he will want, and eliminating that which is useless.

Forest Engineering also is a fad which operates detrimentally to the State by leading Forest Officers astray from the study of beetles. In one Division alone, the one in which this is written, there are four or five suspension bridges up to 287 feet span, and a bigger one projected; a plain log bridge, consisting of two beams which had to be got across a chasm 90 feet wide and considerably deeper, at an angle of perhaps 20 degrees from the horizontal, supported by a single truss resting on the sides of the cliff; a large number of other bridges, cantilever or trestle, some of them of large dimensions; several wire shoots from 1,400 feet span downwards; sledge roads, tramways, wet

and dry slides aggregating a good many miles, and so forth. All these works have been constructed *exclusively by the local Forest Officers.* Had they been made by the Public Works Department the cost would surely have run to two or three times the actual cost. As they stand they have saved the State some two or three lakhs of rupees in cost of transport, *after deducting* cost of construction and working.

Perhaps our esteemed Contemporary can show how two or three lakhs of rupees are to be made out of "practical entomology." It is one thing to know all about a pest, and quite another to exterminate it. A Forest is not a tea garden, and measures that may pay in the latter case may prove sheer waste of money in the former. As a matter of fact, Forest pests, however interesting from a scientific point of view, do comparatively little damage in this country. Their extermination would require a very large special staff at unforeseen times, and the expenditure would be out of all proportion to the benefits derived. "Economic botany" is in a somewhat similar position. There can be but few articles of Forest produce of economic utility whose uses are not now known and recorded. That they are not better known and more widely used is due to the fact that there are other articles of equal or greater utility which can be obtained elsewhere at less cost. It is not the duty of a Forest Officer or of the State, to set up experimental factories at great cost in the hope of finding out a profitable way of utilising a given product. That is the function of commercial enterprise. If commercial enterprise can create a tangible demand for a given product, it is then the business of the Forest Department to show how that product can best be obtained, and the Forest Department is not behindhand in doing so. For instance, turpentine and rosin are being made on a commercial scale and of the best quality; tannin extracts have received a great deal of attention; so have fibres, though there are already before the public more fibres than can be profitably utilised. Rubber is more promising, and to take one instance only, some 3 lakhs of rupees are to be laid out in rubber plantations.

All this is beside the point. It is not the case that Forest Officers know nothing and care less for Botany. The fact is that the Department is undermanned, and the vast majority of Forest Officers have their time so full with necessary out-door work and unnecessary and harassing Office work, as to leave neither time nor energy for anything else. In some Divisions the Forest Officer is up and out with the sun, inspecting fellings, contracts, plantations, &c., till noon or later, office work till dinner time, and sometimes writing far into the night. Some years ago the Secretary of State ruled that the Divisional Officer was not to be of lower rank than a Deputy Conservator, with Assistants under him. Now-a-days the Assistant Conservator has

always a Division, and many Divisions are in charge of Officers of even subordinate rank and subordinate attainments. These are mostly estimable men so far as they go, and cheap, but they are not in their place, and there can be no doubt that every Division ought to be in charge of a fully trained European Officer. It is interesting to note finally that the whole of this indictment and discussion arose out of remarks made by a gentleman who is of great eminence as a botanist, but knows about as much of Forest Officers and their work as about performing poodles. Nevertheless, let us discuss. No harm can come of it, and good may result.

G. B.

Forestry in the British Isles.

Mr. D. E. Hutchins, Conservator of Forests, Cape Town, and lately of the Indian Forest Service, delivered, in November last, a very able and interesting speech, before the Society of Arts, on the subject of National Forestry.* "The Forestry for which I plead," says Mr Hutchins, "is not the necessarily fitful efforts of a few private landowners, nor the founding of quasi-chairs of forestry, at certain agricultural schools; but the national forestry of a powerful Government Department, properly manned and officered with scientific men; a department which, with a million pounds sterling to spend yearly, should work steadily at the formation of national forests, in the sense in which this term is understood in most other civilised countries, but especially on the Continent of Europe."

If we look at the position of Great Britain and Ireland among the States of Europe, it will be seen that in forestry it occupies the lowest place, standing below all the European States. It is even 1 per cent. worse off than Portugal. The following is, in fact, the proportion of woodland in some of the more important European States:—

	Percentage of Woodlands.	
Russia in Europe	36	Scientificially conserved and permanent.
Austria	30	
Germany	26	
Switzerland	19	
France	17	
Portugal	5	
Great Britain and Ireland	4	Parks, small plantations, &c.

*Journal of the Society of Arts, November 24th, 1899. Price 6d. to Non-Members. London.

At the same time the quantity of land available for reforesting in Great Britain and Ireland is enormous. Geographical text-books tell us that one-fourth of the area of England is waste, *i. e.*, neither arable nor permanent pasture land, and that in Wales not much above half the land is in pasture or under cultivation, while in Scotland only about one-fourth the area is arable. Ireland, like England, has about one-fourth of its area waste, *i. e.*, neither cropped nor meadow land.

The timber and forest produce imported into the British Isles, and that could be produced equally well in that country, represent a value of about £20,00,000 sterling. The last returns, published by the Board of Agriculture, give the following figures for 1896 :—

Fir	*£16,000,000*
Oak (including staves) ...	1,500,000
Various	1,649,000

If we take one-third of the last figure as producible in Britain, we have a total of £18,000,000 for imported timber producible in Britain. At ordinary rates of yield, this would require about 9,000,000 acres for its production: 9,000,000 out of 77,750,000 acres, the total area of the British Isles. This is not quite 1 acre *of forest to every 8½ acres of open country*; and as Dr. Schlich has pointed out in his *Manual of Forestry* the moors, mountain land, and waste land generally, added to the area which is at present more or less imperfectly wooded, are large enough to yield easily all the timber and forest produce now imported.

The areas that suggest themselves for extensive reforesting operations within the British Isles are the Mountains of Wales, the English Lake Country and the Scotch Moors and Highlands; the "downs," so common everywhere together with the wolds and other areas where the forest has been destroyed in recent times—the Yorkshire and Lancashire Wolds, the Cotswolds, the weald of Kent. (The word wold comes from the Anglo-Saxon weald, and is the same as wald, the modern German for Forest.) Then there are the now barren and almost waste English moors desolate Exmoor, the wet tor-crowned tableland of Dartmoor, the bleak Yorkshire moors, the peaty Lancashire moors, also the bogs of Ireland.

Mr. Hutchins proposes that a sum of £1,000,000, representing 1 per cent. of the national expenditure, should be set aside every year *for forest work. If this sum* were voted annually by Parliament it would suffice for re-foresting yearly about 100 square miles, taking planting and fencing at £5 per acre, and the average cost of land purchased at £10 per acre.

In a very able, concise, but comprehensive manner, Mr. Hutchins sets forth the reasons in favour of the formation of natural forests, namely :—

1. £20,000 spent every year for wood that could be equally well grown at home.
2. Consols at 2 per cent. National forests will return 3 per cent. and upwards.
3. Shrinkage in foreign sources of timber supply.
4. Fall in the value of land in Britain.
5. Livelihood for the country population.
6. Recreation for the town's folk.
7. Aid in defending the country against invasion.
8. National Insurance.
9. Abatement of smoke nuisance in towns.

Well may Mr. Hutchins exclaim :—" Pondering these things, the conclusion to a Colonist and a Forester is irresistible. England's great want at this time is national forestry. And as one reckons up the gains—£20,000 more produced yearly in the country; 75,000 people kept on the land; a forest playground for every man, woman and child, with a fostering of the love of nature and the beautiful; less smoke, when one considers that this can be produced at no final cost to the public Exchequer (probably a considerable gain), and that for a moderate extra cost we obtain strategic forests and a defensive forest militia—pondering, I say, these things, the strange puzzle of the present position becomes stranger and stranger."

Stimulating the Germination of Teak Seed.

Experiments to accelerate the germination of teak seed have been undertaken in various divisions of the Bombay Presidency, and with excellent results.

The teak seeds are placed in a shallow pit 1½ feet deep, which is afterwards filled with water to soak them. Subsequently the seeds are kept moist by being watered every four days. Seeds so treated show signs of germination in another 5 days.

A second experiment was made in which the seeds were at first soaked in warm water for 24 hours, and the Divisional Forest Officer, Surat, Mr. Hodgson, writes as follows regarding the results obtained :—" I consider it would be a waste of time to grow seedlings in such a way that they take 3 months to appear above ground, for the seed invariably germinated in 12 to 24 hours in this Division by soaking in luke warm water, and plants show above ground in a few days "

Trade in Terminalia Bellerica Nuts.

Mr. G. M. Ryan, Deputy Conservator of Forests, Northern Circle, Bombay, has lately issued a memorandum on the subject of Terminalia bellerica nuts in which he draws attention to a vast source of hitherto untapped wealth in the Northern Forests of Bombay; for it is difficult to believe that the matter has not already received considerable attention elsewhere. Mr. Ryan writes as follows :—

"A report on the nuts of Terminalia bellerica, a tree common in all the Thána Divisions, was submitted by the Divisional Forest Officer, South Thána, in which he showed that in 1889 the value of these nuts in the English market was reported to be £7 to £8 per ton, a price even higher than that of some myrabolams. Messrs. Killick Nixon and Co., Bombay, have agreed to undertake the shipment of a consignment of these nuts from India, to ascertain their present value in England. If they (the nuts) approach anything like the price quoted for them in 1884, every likelihood presents itself of a new source of revenue springing up, for in addition to this Presidency, the Central Provinces also, it is found, contain Terminalia bellerica in large quantities. The annual export of the nuts under favourable conditions would, it is estimated, amount to about 1,000 tons from the Bombay Presidency alone."

As Mr. Ryan correctly implies, the Terminalia bellerica tree is common in the plains and lower hills throughout India and Burmah, and also in the Oudh sal forests; and the fruit has long been known as one of the myrabolams of commerce, and is exported as such. Myrabolams were recently quoted in the London market at about £4 per ton, and we shall be glad to hear of the financial results of the undertaking.

Forest Fires in the United States of America.

The actual cash damage done by forest fires is hard to estimate. A commission has recently been appointed to make a canvass, and has reported that in the last twenty years, in the territory of the United States and the land in British North America, the damage has footed up $800,000,000. In the one year of 1880, a territory was burned which comprised at least 10,250,000 acres. The value of the forests alone was $25,000,000. And the year chosen was not one particularly noted for the frequency of its fires. In the West, where a thick growth of trees, a long dry season and the reckless

prodigality of the inhabitants make a combination favourable to large losses, the damage is wonderful. The smoke from the frequent fires is so thick that it renders the navigation of Puget Sound dangerous. Thirty million dollars worth of stumpage has been burned in one part of the State of Washington. During the year 1898, the number of fires was exceptionally large, and, though the reports of the damage are not yet all in, there is sure to have been a loss of property footing up millions and millions of dollars. From the time of the occupation of the Indians to the present day, there has been a succession of these forest fires. It is a question how to deal with them. Many States have forest laws, but they are not well enforced. The fruits of the carelessness and waste of the early settlers are now being gathered by their descendants. Many men are needed to combat a fire, and the most earnest co-operation is necessary for satisfactory results. The danger from this source does not seem to be decreasing, and when we think of so powerful a factor for evil, moving at a speed sufficient to overtake a horse on the gallop, it will be seen that prompt measures are necessary to protect what remains of our once proud and still extensive forests. There has been a very long season of dry weather lately, so dry that the marshes on the lakes were on fire at one time. The appointment of fire marshals is not enough. They must be given power to compel services, and a tax for the special purpose of reimbursing burned-out settlers and the bringing of any culprits to justice might be instituted. If something is not done we shall have the mortification of seeing our forests disappear beyond recall. It is extremely difficult to get anything but approximate figures concerning the number of deaths resulting from forest fires, but isolated paragraphs tell something of the story. During the terrible fires in 1894, when millions of feet of lumber burned, the town of Hinckley lost over 200 souls of its population. In 1871, a year made so memorable by its great conflagrations, the loss of life from the towns on the west shore of Lake Huron was over 5,000, and this territory was a mere tithe of the burned-over country. In the Minnesota fires of four years ago, the villages lying on a line between Carlton and Pine City, where the flames took their course, in 130 miles of territory over twenty towns were wiped out, and in Carlton and Pine counties alone the loss of life was over 1,000 persons. If one considers that these figures come from small tracts, and that they are from but one fire, while millions of acres are burned over every year, and the fires have been doing their work since America has been in existence, some idea of the awful loss of life may be approximated. It is safe to say that fire in the forests has been responsible for the deaths of millions of people.—(*Detroit Free Press.*)

Forest fires are receiving considerable attention in the United States of America; and investigations of the causes, effects and means of prevention of forest fires are being carried on this summer in many of the States. The following extract is taken from the *American Forester* for March 1900:—"Besides field study, designed chiefly to discover means of preventing the evil, the Division of Forestry is making a historic record of all important fires which have occurred in the United States since 1754. Although incomplete as yet, this indicates that the annual recorded loss by forest burnings in the United States is, at the very lowest, 20,000,000 dollars. It will probably run far above this sum, as the Pacific Coast States have been only partially examined. Accounts of over 5,500 disastrous fires have been obtained in the 17 States already examined. These records are taken chiefly from newspapers, and where it has been possible to compare them with the figures of practical lumbermen, it has been found that the tendency of the Press is to underestimate the damage.

Again, we find that two bills to prevent the spread of forest fires in the New York State have been introduced in the Senate. The first is making railroads liable for all damage done by fire, due to the railroad's property or employés. The other provides for the employment of men to fight fires in case of danger to forest reserves; and the enforcement of such laws would doubtless have a very salutary effect.

Lightning-Struck Trees.

The German Government has recently caused an inquiry to be made into the subject of lightning and its effect upon trees, the observations having been entrusted to the overseers of nine foresting stations scattered throughout an area of nearly fifty thousand acres in the district of Lippe. It was found that of all forest trees, the oak was most susceptible to the attacks of lightning. The forests were found to comprise various kinds of trees in the following proportions:—beech, 70 per cent.; oak, 11 per cent.; pine, 13 per cent.; and fir, 6 per cent. Of the two hundred and seventy-five trees which suffered from lightning during a period of several years, no fewer than 58 per cent. were oaks, 21 per cent. firs, 8 per cent. beeches, and 7 per cent. pines. It is noteworthy that it has been stated by some English authorities that the beech is seldom or never struck by lightning. The truth of this statement has long been disproved, and it is interesting to see that the beech in Germany appears to be more often the subject of lightning-stroke than the pine.—(*Chambers Journal.*)

The Effect of Grazing on Forests.

The question of grazing in the Western forest reserves (U. S. of America) has been taken up by the Department of the Interior for a complete investigation of the claims advanced by the advocates and opponents of the opening of the Reserves to sheep-grazing. The Secretary of State has lately written to the Secretary of the Department of Agriculture, asking that the Division of Forestry investigate the effect of sheep-grazing on the forests and an inquiry will be begun at once. As no general rule can be applied, each reserve will be studied separately.

This work will be conducted by the Division of Forestry, which has prepared a comprehensive plan for securing information.

As it is desired to collect impartially the testimony of both sides, lists of questions will be sent to the thousands of sheep-grazers and their opponents for the expression of individual opinions concerning the effect of grazing. This information will be used later in connection with the official examination of the reserves, which will begin July 1st, in which botanists, irrigation experts and other scientific men from all parts of the United States, will be engaged for several months in the field.

In the letter referred to above, the Secretary of State enumerates the points upon which he desires to lay special emphasis, as follows :—

" Grazing in the national forest reserves, being one of the most important of all the questions which relate to them, will naturally form a chief subject of the reports. In the necessary investigations and in preparing the reports, I have the honor to request that special attention be given to the following phases of the subject :—

" 1. The grazing industry in the forest reserves in relation to taxation and the general prosperity of specified localities.

" 2. The relation of grazing to the forest fires.

" 3. *The relation of grazing to the preservation and reproduction of forests.*

" 4. The relation of grazing to irrigation and water-supply.

" 5. The relative effect of grazing by various kinds of stock.

" 6. Moderate grazing and over-grazing in forest reserves."

The present investigation has been brought about largely by the controversy which has raged for many years in the West, involving cattle-men, wool-growers and farmers throughout that entire section.

The recent increase of irrigation has added to the bitterness. Government action in the matter has been hastened by the establishment of forest reserves. In view of the injury to the forests in many sections from over-grazing, all reserves except those in Washington and Oregon, and the Black Mesa Reserve in Arizona, which is to be opened to 300,000 sheep at 3 cents a head, are closed to sheep by an order issued last May. This step

has raised a storm of protest from wool-growers, who claim that no harm is done by grazing under proper restrictions. Many are reported to have driven their herds into the mountains last summer in defiance of the law.

Against the sheep owners are arrayed the cattle-men and farmers, and especially the irrigators, who claim the practice means disaster to agriculture in the lowlands. These argue that sheep destroy the forest cover in the mountains and thus diminish the water-supply. They are said not only to eat the young growth which is to perpetuate the forest, but to trample innumerable seedlings and destroy the layer of leaves necessary to keep the soil in good condition. Sheep herders are accused of burning large areas in order to secure a growth of grass. While the Government will decide the matter only in the case of the forest reserves, these include a large part of all the summer ranges of the western sheep-raising states, and the results will be of great importance to the wool-grazing industry.—(*The Forester*.)

The Camphor Industry for India.

A Correspondent writes to the "Madras Mail":—Some little time ago, when questions touching the introduction of new and untried industries into this country were attracting the attention of planters and investors, the suggestion was thrown out that the cultivation of Camphor might easily and profitably be started in Southern India; and I believe that some experimental measures with the tree were contemplated by certain owners of planting properties in Travancore. I am not aware to what extent these experiments, if undertaken, were carried, but I think it worth while that practical investigations should be set on foot with a view to decide whether it is possible to propagate the tree on a remunerative scale in the Peninsula. There is at least some reason to believe that success of an encouraging nature would attend such experiments, for the camphor tree is rough and easy of propagation, its reproduction being attended with but little difficulty. Moreover, the natural orders in which the commercial varieties of the tree are placed are well represented in our Forests and jungles, where they thrive and flourish. Besides, the camphor tree finds a congenial home in mountain Forests and in the woods lying near the sea coasts, and such conditions, combined with climatic and atmospheric conditions, are almost identical in many parts of this Peninsula with those which prevail in the countries which the tree claims at present for its habitat.

Judging from the manner in which they treat it in China, Japan, Sumatra and Borneo, where it is practically left to grow wild, and where no methods whatever are adopted for conserving the strength and preserving the commercial value of the tree,

the presumption is that were the tree planted on Indian soil and cultivated with proper regard to the laws of vegetable conservancy and reproduction, it would abundantly repay the trouble and cash expended on it. Botanists have long been at variance concerning the exact relations which the camphor tree of Sumatra bears to the species found in Japan and Formosa; but whatever these differences may be, it is certain that if one variety could be successfully cultivated here, the same success might be expected to attend the cultivation of others. Broadly speaking the Sumatra variety belongs to the natural order Dipteraceæ, and has been named Dryobalonops aromatica by one authority, and Shorea camphorifera by another. The Japanese variety which, by the way, the Chinese were not slow in importing into their country, is named Laurus camphora, and has been placed in natural order Lauraceæ. The Sumatran species is divided for commercial purposes into three varieties, which are distinguished by the external colour of the bark, which is sometimes yellow sometimes black, and not seldom red. The tree shoots up, straight and grows to an exceptional great height, towering above the subarbric, scrub vegetation amidst which it grows with a gigantic crown and with a stem which not seldom runs to about 20 feet in girth. The leaves are small, oval shaped, and long, with a strong smell of camphor. The fruit resembles the acorn, but is surrounded by five petals, which make it resemble a lily to some extent; it possesses a strong flavour of camphor, and is commonly eaten when ripe; it is also converted into a kind of dry confectionery.

The period of efflorescence is in January and February, while fructification lasts from March to May. It is believed to be very unhealthy to remain near the tree during the flowering season, owing to the extraordinary heat which it then gives off.

The two commercial products which are obtained from the tree are a resin, that comes away readily in flakes, and an oil which exudes from the cuttings when the tree is felled and is then collected in large quantities. The resin is found in the concrete state in the natural fissures and crevices of the tree, and in the knots and swellings of the branches, but no external indications reveal its existence. Hence, camphor gatherers either make deep incisions in the tree or even cut it down in order to get at the resin, and seeing that a considerable proportion of the trees thus blindly and indiscriminately felled are likely to contain neither resin nor oil, it can readily be understood what an enormous amount of wastefulness is suffered to go on. When a tree containing camphor has been felled, it is universally divided into several blocks, which are then reduced to pieces of much smaller dimensions, and from the interstices of which the camphor is extracted in grains and scales. The substance is afterwards

assorted according to its intrinsic, and therefore, marketable, value. The process observed in freeing the camphor from foreign bodies and impurites generally is to steep and wash the crude substance in water, soap being sometimes used. It is then passed through sieves or screens, particular care being taken to differentiate between the natural resin and the artificial substance produced by a forced concretion of the essential oil. Although the resin and the oil are not uncommonly found in separate trees, the same tree has frequently been known to yield both products. The oil is gathered at the time the trees are cut down; it is a very volatile essential substance, and used as may be known, for a variety of medicinal and other purposes. The resin also is turned to a great many uses, and bazaar dealers have a weakness for apparently increasing its weight by moistening it.

Sumatran Camphor has long been highly esteemed by the Chinese, who it is said, will give from 80 to 100 times more money for it than that which they obtain for their own camphor, which latter, however, our pharmacists believe to be at least equally beneficial. The species of camphor which is obtained from Formosa is the yield of a tree that grows luxuriantly in the mountains and forests of the interior of that island. The tree attains in about twenty years a height of from 30 to 40 feet and upwards. It is most recklessly cut down by the aborigines both for camphor making, as well as for being sawn into planks and knees for the buildings of junks and boats of all descriptions. Since the island came into the possession of the Japanese, the industry, instead of undergoing improvement, has only been further threatened by its conversion into a State monopoly so indifferently protected that any amount of illicit felling and manufacture goes on unchecked. Nothing has been done by the Japanese Government to prevent this reckless waste of the Forest, or to provide for the re-afforestation of uninhabited tracts, and though, according to a British Resident, who had been in the country for over a quarter of a century, there is no reason to fear, that the supply of trees will run short for many years to come, still, seeing that in these days there is a steadily increasing demand for camphor, it appears highly desirable that our own Peninsula should not be indifferent about making an effort to ascertain if it could not, with much profit and credit to itself, enter into competition with the camphor producing countries of the far East. One important circumstance to be borne in mind is that in Japan, Formosa, Sumatra and Borneo, the camphor industry has, during all these years, paid handsomely without any trouble being expended on its protection or development. This being so, there would be no reason to apprehend failure in this country, if a proper system of cultivation is pursued and due regard is paid to forest economics. As regards the acclimatisation of the trees, I think that there need be no ground for apprehending failure.

Manufacture of Turpentine and Resin in the Southern States of America.

The manufacture of spirits or oil of turpentine, and resin, has been, for many years, the principal industry of the entire part of the Southern States known as the long leaf pine belt, and the business of "yarding" and shipping of these and other naval stores has been, and is now, the basis of the prosperity of many of the cities on the South Atlantic and Gulf Coast.

Both spirits of turpentine and the solid product known as resin are obtained from the exuded gum or resin of various members of the yellow pine family, but principally of the variety *Pinus palustris*, or "long leaf" yellow pine.

The resin, which is of a semi-solid consistency and whitish in colour, is insoluble in water, but readily soluble in ether or spirits of turpentine. It is obtained from the tree by boxing, or cutting a deep notch in the trunk, about a foot from the ground. These "boxes" hold about a quart, their number is limited by the diameter of the tree, the usual rule being to leave 12 inches of bark between each box, this giving two to four and sometimes six boxes to each tree, the box being 10 to 12 inches across the opening. Ten thousand boxes constitute one working unit or "crop," requiring from 100 to 200 acres in the new regions along the Gulf Coast, and from 500 to 1,600 in the "worked-out" districts of North Carolina.

The boxes are cut with an axe having a very long and narrow blade, and short and heavy handle. This is done during the winter months, when other work on the turpentine farm is at a standstill. Upon the opening of the warm weather, which causes a flow of sap into the boxes, the trees are "chipped" or scarified by removing the bark and wood to a depth of about an inch just above the box. This operation is repeated every week during the season, each "chipping" exposing about an inch and a half further up the tree, but maintaining the same depth. The tool used is called a "hack."

The gum exudes from the sacrified surface and flows down into the box, whence it is collected every four weeks by means of a "dipper," which is simply a flat pear-shaped blade, and sets into a handle. The average weight of a barrel of "crude" is 240 pounds, and a crop of first year or "virgin" boxes should yield 35 to 50 barrels per dipping, or 245 to 350 barrels during the season, decreasing to 12 or 16 barrels per dipping during the fourth year, at the end of which the farm is usually abandoned and turned over to the timber men, although some of the smaller landowners in the older districts, especially in North and South Carolina, work their trees as long as they can get anything out of them.

The stills usually hold from 10 to 50 barrels of crude, and are made of copper. The kettle, which is in a brick setting with a furnace underneath, has an opening near the bottom with a grate faucet, out of which to run the charge after distillation.

A little water is run in when the still is charged, and heat applied gently at first, being gradually increased until the whole mass reaches the boiling point, where it is maintained during the remainder of the process. The steam produced by the evaporation of the water passes over into the worm, bringing the turpentine in a vaporised form with it, and, being condensed, runs off into a vessel placed to receive it, in which the water settles to the bottom, and the turpentine, being of a less specific gravity, collects on the surface and is dipped off into barrels. Water is constantly added to assist in the vaporization and to prevent burning of the charge. With a glass the distiller notes the proportion of the spirits and water coming over, and, when the spirit has decreased to about one-tenth of the whole, the distillation is stopped and the remainder of the charge is run out into a wooden trough, passing first through a strainer of No. 6 mesh, next through one of about No. 40, and last through a No. 80 mesh. While still hot it is dipped up into barrels.

The number of charges per day which can be run in a still of ordinary capacity is from two to five, depending on the character of the crude and the time of distillation.

A charge of 12 barrels of crude gum should yield 120 to 130 gallons spirits, and seven or eight barrels of resin.

Spirits of turpentine, fresh from the still, is perfectly clear and transparent, with a faint, pleasant, aromatic odour, and is very different from the ill-smelling, yellowish liquid that we usually see in paint stores.

The spirit barrels are prepared by being coated on the inside with glue, which, being insoluble in turpentine, renders them impervious to the action of the liquid, and prevents leakage.

There are 15 recognized grades of resin, those known as W. G. (window glass), and W. W. (water white), being the finest and most valuable, and from N., which is very clear, the grades run through M., L., K., J., H., etc., to A., which is almost black. Of these the W. W. and W. G. grades are produced from the "virgin dip," or first year's run, each subsequent year's run producing a poorer grade.

During the latter part of the season, as the weather becomes cooler and the flow of sap diminishes, the gum forms on the boxed face in a hard white mass greatly resembling honeycomb. The scraping off and distilling of this is the last operation of the season. The scrape, which amounts to from 70 barrels per crop the first year to 100 barrels in the fourth, produces resin of an inferior grade, and but little turpentine.

The next important step is the shipping of the finished product. The stills are usually situated at a considerable distance from transportation, and most of the larger operators either build tram roads to reach the shipping point, or else make use of those built by the sawmill people. The rosin, which is shipped in very rough barrels, made at the still, and holding 350 to 400 pounds, is, upon its receipt by the factors at the seaport, first weighed, then graded, and after reheading, is stored in open yards, to be presently loaded upon vessels for export. The vessels usually employed in the foreign trade are Norwegian and Swedish barks, of a tonnage varying from 500 to 1,100 tons.

The spirits receive rather a different treatment, being run from the cars under open sheds, and the barrels emptied and re-glued, if necessary. The spirits is then re-barrelled, if destined for export, or run into tank cars, if for shipment to the interior.

A shipload of spirits when the price is ruling between 30 and 40 cents per gallon is rather more valuable than the average reader would at first suppose.

By far the largest amount of resin produced is consumed in the manufacture of soaps and varnishes, of which it is an important constituent. A great deal of it is re-distilled for resin oil, which is used as a basis for various grades of machine oils, and in the manufacture of waggon grease, printing inks and lacquers.

Spirits of turpentine is used in the manufacture of varnishes and paints, and to some extent in chemical operations and medicine.—(*Scientific American.*)

New Tanning Agents.

Burmese Pyinkado or Iron-wood Tree Sawdust.—An extract has recently been obtained from the sawdust of the pyinkado or iron-wood tree of Pegu and Arakan, which is rich in tannin and of good colour, and which is consequently capable of making a fine tanning agent. About a year ago the refuse of the sleeper works in Burma was found to be astringent and useful for leather manufactures; and this casual discovery led to satisfactory experiments being conducted from various industrial works in Burma. Professor Procter, of Yorkshire College, Leeds, who conducted the experiments on it, remarks that the question of making it at a profit turns on the cost of the sawdust; but as this can easily be obtained in large quantities, there should be little or no difficulty in producing the new tanning agent.—(*Capital.*)

The same paper, *Capital*, also reports that experiments are being made with a new tanning agent obtained from the pods of the *tara* or *teri* shrub of Burma, Chittagong and Assam; and great

superiority is claimed for the new tanning substance over *divi divi* and the numerous other agents now in use. Experiments, conducted at the Bristol Tanner's Laboratory, showed that 33 per cent. could be extracted. The tannic acid thus obtained forms with gelatine a snow-white precipitate: while on the addition of certain chemicals, various colours are produced—and thus it would appear to be a good dyeing as well as tanning agent. It has also a marked advantage over *divi divi* now in use, inasmuch as the aqueous liquor of the *tara* does not undergo deleterious fermentation. Attention was first drawn to the *tara* plant about half-a-century ago; but little or nothing has been done till now to utilise its tanning properties. It is extremely doubtful, however, if the introduction of the new agent will be of material benefit to the moribund tanning industry of this country, though a good trade in the article itself may spring up with America and Europe.

Rubber in British Burmah, Bolivia and Mexico.

The Government of India, on the recommendation of Mr. Ribbentrop, Inspector-General of Forests, have just taken an important step in connection with the cultivation of rubber trees. It has been fully proved by experiment that the Brazilian tree will thrive, reproduce itself and yield rubber of the best quality when cultivated on the Tenasserim Coast. The Government have therefore sanctioned the establishment of a plantation of 10,000 acres of these trees, at a cost of Rs. 2,10,000. It is expected that at the end of twelve years the plantation will have paid its cost, and will thereafter pay one lakh net annually. As the trees will be self-producing, this income will be a permanent one. The calculation is based upon proved facts, the only uncertainty being the maintenance of the present high price of rubber, the demand for which is very great.—*(Pioneer.)*

We also hear that a tract of 4,700 square miles of rubber land in the Upper Amazon country has just been purchased from the Republic of Bolivia. Arrangements have been made for sending Americans to work the orchards, and it is intended to obtain the labourers from the United States, as the native labour, which is entirely Indian, is unsatisfactory. Most of the labourers, of whom 5,000 are required, will be negroes, and special inducements are to be held out to them to take their families with them and become permanent settlers.

Consul-General Hardy writes from Mexico that land suited to the growth of rubber can be had anywhere from $1 to $15 per acre. The titles will be found vested in private ownership; none are in the Government. The land will, in all cases, be a dense jungle. Cacao, pineapples, and bananas can be grown as well as rubber. Prairie, or grass-land, is not adapted to this

product. Rubber may be planted from branch cuttings, root cuttings, and from trees grown in the nursery from seeds. From 150 to 300 trees are set to the acre, and they are tapped anywhere from five to fifteen years after planting, according to the locality. Under the most favourable conditions, a tree will yield an average of one to two pounds of rubber. The present market price at Frontera is $1·44 Mexican (about 67 cents in United States currency) per pound. The tree is long-lived, and the production increases with age No machinery is required for handling the gum. The rubber plantations of Mexico, as a rule, are remote from centres of population; they are always thinly inhabited. Oriental labour must be imported. The approximate wage is $1 silver (47 cents gold) per day. Knowledge of the language of the country is desirable for a person about to engage in the cultivation of rubber. The rubber tree of Mexico is found growing from the Guatemalan boundary as far north as Tuxpan, on the Gulf Coast, and as far north as Colina, on the Pacific Coast. The maturity of the tree and its production are measured by the quantity and uniform distribution of the rainfall, together with high temperature, throughout the year. In low altitudes, localities of 150 and 200 inches of rainfall, distributed over eight or ten months in the year, enjoy the best conditions, although rubber does grow where they have six months of rain and six months of dry weather; but in these localities it requires from 12 to 15 years for a tree to mature, whilst in districts with an ample rainfall it will flower within five or six years.—(*United States Consular Report.*)

Electro-Culture.

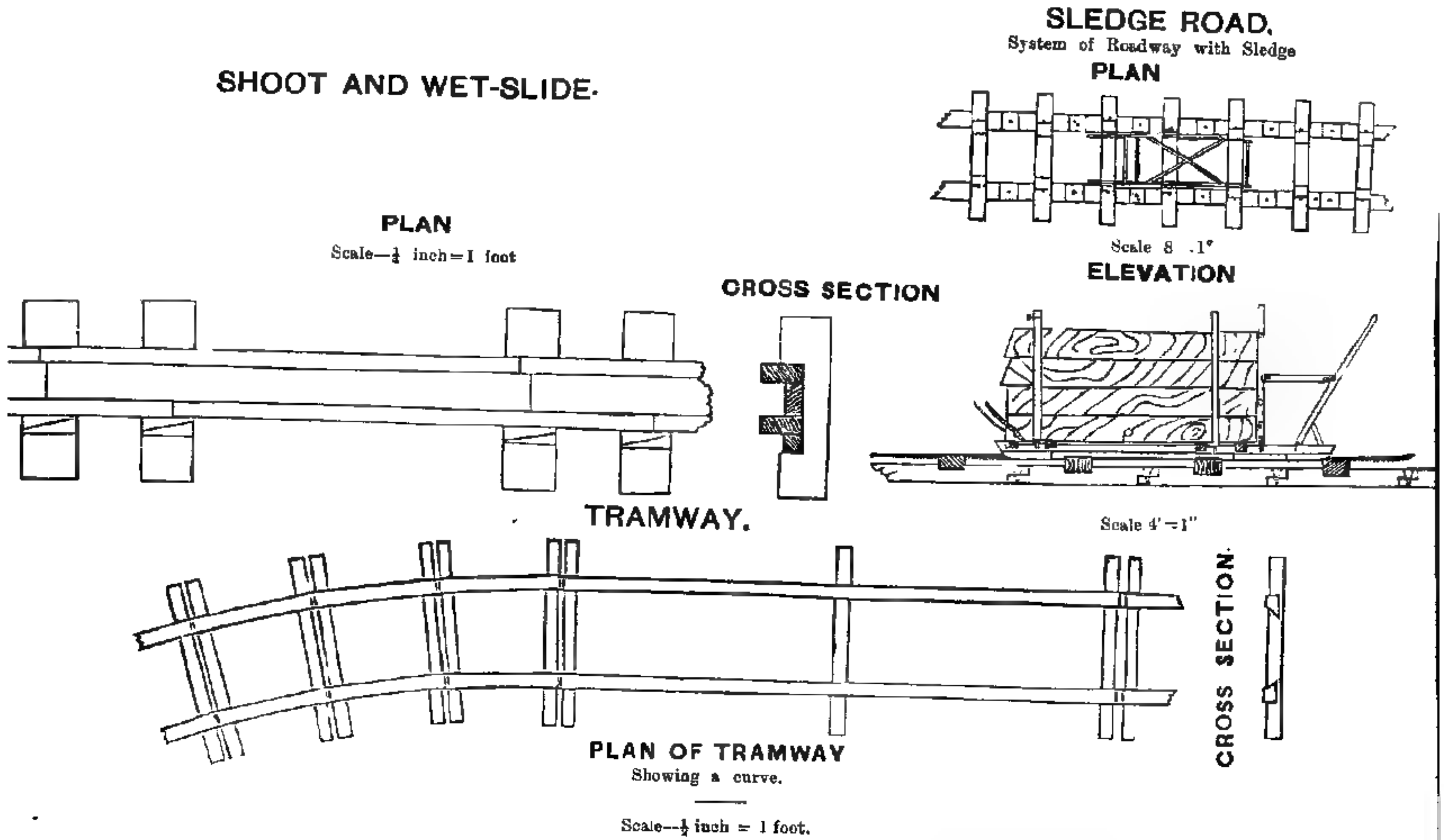
The results obtained by culture under the influence of electric light are fairly well-known, and the growing of lettuce for salads, in spacious greenhouses with the aid of electric light, is already a profitable industrial pursuit in the United States (near Chicago and elsewhere). However, the use of electric currents for stimulating vegetation, although it was studied more than fifty years ago (by Ross, in 1844—46; continued by Forster, Sheppard, Fichtner, &c.), still remains unsettled. A communication upon this subject made by a Russia Engineer, V. A. Iyurin, before the St Petersburg Electro-Technical Society, contains some welcome information upon the work done in this direction in Russia by M. Spyeshneff and M. Krankoff The former experimented a few years ago on these different lines. Repeating well-known experiments on electrified seeds, he ascertained once more that such seeds germinated more rapidly, and gave better fruit and better crops (from two and half to six times higher), than seeds that had not been submitted to preliminary electrification. Repeating next the experiments of Ross—that is burying in the

soil one copper and one zinc plate, placed vertically and connected by a wire—he found that potatoes and roots grown in the electrified space gave crops three times heavier than those which were grown close by on a test plot; the carrots attained a quite unusual size, of from ten to twelve inches in diameter. Spyeshneff's third series of experiments was more original. He planted, on his experimental plot, about ten yards apart, wooden posts provided at their tops with mettallic aigrettes connected together by wires, so as to cultivate his plants under a sort of network of wires. He obtained some striking results; one of which was that the growth and ripening of barley were accelerated by twelve days. Quite recently M. Krankoft undertook a series of laboratory experiments upon boxes of soil submitted to electric currents. The temperature of the soil was raised by these currents; its moisture decreased first, but began to increase after a course of three weeks (the same increase of moisture was also noticed by Fichtner); and finally, the amount of vegetable matter in the soil was increased by the electric currents. With what is now known upon the influence of micro-organisms upon vegetation, further research on similar lines is most desirable and very promising.—(*Nature.*)

Vitality of Seed in Liquid Hydrogen.

The command of liquid hydrogen in large quantities has enabled Professor Dewar, in conjunction with Sir W. Thiselton-Dyer, to try an interesting and significant experiment on the vitality of seeds. It had already been shown that they can retain the power of germination after continuous exposure for several days to the temperature of liquid air. Last year the experiments were carried a step further, and commercial samples of the seeds of barley, vegetable marrow, mustard and pea were literally soaked in liquid hydrogen for more than six hours; yet when they were sown they germinated in just the same proportions as other batches of the same seeds which had been subjected to no such heroic treatment.—(*Times*).

KULNI EXPORT WORKS.



THE

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The Kulni Export Works, Jaunsar Division, N. W. P.

I.—Description of the Forests.

The Tehri-Garhwal leased deodar forests are situated in the Upper Valley of the River Tons, and on its right bank. The forests were first leased by His Highness the Raja to the British Government in the year 1864, and on the expiry of this lease in 1885, it was renewed. The new lease is for 20 years, from the 1st April 1885, with option of renewal for a further period of 20 years.

Briefly the forest may be said to consist of a series of narrow valleys, formed by the tributaries of the Tons river; the Deota, the Bamsu, the Saras, and the Kotigad valleys being the principal ones, each separated by very high, generally precipitous, rocky and even inaccessible ridges.

The "gâds" or mountain streams of these side valleys rise very abruptly, and in places even in steps, so that important waterfalls are met with. The result of this is that the vegetation in a comparative short distance may vary very considerably; and, indeed, as one rises certain well-defined zones are met with. Below, where the tributaries join the Tons is the Chir (Pinus longifolia) zone, with which are associated various broad-leaved species, Betula acuminata, Celtis australis, Populus ciliata, Ulmus Wallichiana, Æsculus indica, Euonymus, Meliosma, and others.

Rising still higher and approaching the heads of the valleys, the Deodar zone is entered; and, again still higher the *Karshu* (Quercus semecarpifolia) and the Fir zones. The Deodar, however, is the only tree to be considered in working these forests. The Chirs, as a rule, are outside the leased areas; and the present market rates render the exploitation of the oaks and the firs, from these remote forests, an impossibility.

During the course of the first lease (1864 –1885), the exploitation of deodar trees from these areas was carried out in a very spasmodic and fitful manner, and indeed very great difficulties had to be contended against. Departmental timber

operations were first begun in 1869, but on account of the extreme cold and snow very little was done during the year; and it may be interesting to quote a few sentences from the report of Colonel Pearson, the then Conservator. "The work in the Tons," he writes, "has been commenced under great difficulties from the daily increasing scarcity of labour in the hills, and the difficulty of keeping up a regular supply of food for large gangs of workmen in a country as yet unprovided with roads. The bites of the "potu fly"* also are a terrible scourge to plainsmen, and just before my return to the Tons last June, 110 pairs of sawyers all bolted off, declaring that nothing should induce them to work in such a place. This has necessitated the collection of hill sawyers, whose work is of much inferior quality to that of the plainsmen, and in the meantime sawing is nearly stopped." However, by perseverance and judicious management, the prejudices of the sawyers were eventually overcome, and work goes on steadily now without any mishaps.

The records maintained during the years 1869—1885 show that some 20,000 deodar trees were removed, including 5,000 dry trees. All the trees, removed were over 2 feet in diameter. In addition to the fellings, a certain amount of planting and cleanings of Kail over deodar and ringing of inferior species were carried out, in order to encourage in every way the growth of the deodar.

In the year 1885, on the renewal of the lease, a working plan† was prepared for these forests by Mr. N. Hearle, Deputy Conservator of Forests, N.-W. P., solely as regards the exploitation of the deodar. It is not necessary here to discuss the provisions of the plan, as being outside the scope of this article, but the following extract from the Introduction to the Working Plan will sufficiently explain Mr. Hearle's views regarding the working of the Jaunsar deodar forests:—"It has been found that deodar forests whose resources are drawn on for the first time, and where costly export works are required, can only be worked remuneratively on a large scale, and that, in consequence, large working circles have to be formed. The present plan, therefore, when it prescribes that the Tehri leased forests, shall be worked through in 20 years, regards them as forming a portion only of a large working circle, the precise composition of which cannot be determined until the remaining deodar forests in the Jaunsar Division have been valued. In fact, there seems no good reason for treating them apart from the other forests, as the British Government has a right to renew the lease for a further term at the expiry of the present lease in 1905."

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* Simulium sp.

† Working Plan of the Tehri Garhwal leased forests, Jaunsar Forest Division, North-Western Provinces and Oudh. By N. Hearle, Deputy Conservator of Forests. Government Press, Allahabad, 1888. Price Rs. 2.

The Working Plan consequently, lays down that 2,000 green trees over six feet in girth are to be departmentally felled annually, and in addition all dry, standing or fallen trees in the compartments worked over are to be utilised, "such fellings yielding, it is anticipated, about 100,000 metre gauge sleepers each year." The one important provision of the Plan, as regards the construction of export works, lies in the fact that each valley or "gád" is to be worked out separately and in turn, compartment by compartment, so that the work in any one valley continues for a certain number of years, as may be gathered from the following statement of fellings:—

Year of Selection felling.	*Name of Valley.*
1885—1892	The Deota Valley.
1892—1896	The Bamsu Valley.
1896—1897	The Sarás Valley.
1897—1902	The Kulni Valley

This arrangement of the fellings renders possible the construction of costly, though imperative, export works, without which the extraction of the produce at a profit would become a difficult matter. Important works, showing the greatest skill and ingenuity in their construction, were accordingly undertaken both in the Deota and in the Bamsu valleys when the time for working those valleys came round, and very interesting accounts of these works have been published.*

In the present article it remains, therefore, only to give a short description of the works devised for the exploitation of the deodar in the Kulni valley and its branches. To obtain a correct understanding of these, it will be necessary in the first place to give a short description of the valley and its forests, and Mr. Hearle's account is here reproduced:—"The whole area forms the upper basin of the Kulni gád. The valley of the "gád," as one ascends from the Tons, is somewhat narrow, and there are no important tributaries: but about a distance of 6 miles from the mouth of the stream it begins to spread out like a fan, the gád giving off one important tributary after another, and these

*Report on the Deota Sledge road, by E. Mc A. Moir, 1885.
Indian Forester, Vol. XXIII, page 282. Also, Vol. XV, page 293, Journals of Forest School tours.

again sub-dividing. From below, at the point where this begins, the upper basin has the appearance of a large, semi-circular bay bounded along the main ridge by, in many places, enormous and *almost perpendicular masses of rock, the rich deodar forest* being concealed in the valleys of the various tributaries, the principal being the Kangagad, Deotalgad, Kunigad, Dwantigad, Siligad and Jodargad. The basins of those tributaries at their lower end are narrowed into deep, rocky, precipitous gorges, giving rise to some very fine waterfalls. This peculiarity helps to separate very distinctly the upper from the lower basin of the main gád, and the one is stocked with deodar and karshu oak, the other with chir. It is this line of precipices, therefore, which mainly forms the outer boundary of the forests. The whole of the forest faces south-east, with a succession of slopes on the right and left banks of the various gáds, having, as a rule, north-easterly or easterly and south-westerly aspects, respectively This alternation of aspects exercises a most marked influence on the configuration of the ground, the exposed slopes being usually very precipitous and rocky, and not unfrequently inaccessible, whilst on the other the gradient is generally moderate or steepish, not often exceeding 35°.

"The stock in this forest exemplifies in an admirable manner the effect of aspect and altitude on forest vegetation in these regions; thus along the main ridge there is the usual belt of karshu(1) rai(2) and morinda,(3) whilst in the central part of the forest, beginning from the south-west, we find a succession of ravines and streams, including the Kangagad, having a course almost due east, so that all the slopes on their right banks face due north and it is on these slopes which have a moderate gradient that we find dense forests of rai, morinda, moru(4) &c., with usually only a few scattered deodar, chiefly on ridges; whilst on the opposite and precipitous slopes, facing due south, we meet with either a pure deodar forest or this species mixed with kail(5), or occasionally with a few rai; many of the slopes being, however, too precipitous for working purpose. Then come the Deotal and Kuni gads running in a south-eastern direction, so that the slopes on either bank have, respectively, north-easterly and south-westerly aspects; on the former slopes we find a mixed forest of deodar, rai and moru, and in the lower parts either kail and deodar or ban(6) oak, with large well-grown deodar, rai, and kail; on the south-westerly slopes the deodar is almost pure, but there are only a few *workable places. Next we come to* the Dwanti, Sili and Jodargads, all running almost due south, and consequently, with the compartments formed out of their basins, facing due

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(1) Quercus semecarpifolia. (2) Picea morinda. (3) Abies Webbiana.
(4) Quercus dilatata. (5) Pinus excelsa. (6) Quercus incana.

east and west; in compartments with an easterly aspect in the Dwanti and Siligads there is, for the most part, a splendid deodar forest with a few rai, moru, and kail, ban and kail predominating in the lower parts with scattered deodar, whilst on similar slopes of the Jodargad there is pure deodar forest above, with open grassy slopes containing scattered deodar and kail lower down. On the westerly slopes there is almost a pure deodar forest and the ground is mostly workable. Thus as the aspect veers round from due north to due east, so does the stock change gradually from a pure fir to a pure deodar forest ; which latter type is almost always found on parts facing the west and the south, but is here often unworkable, owing to the precipitous character of the ground.

"There are a large number of fine, tall, well-grown deodar throughout the forest, the Dwanti, Sili and Jodargads being the three richest blocks. The forest is practically a virgin one, and there are no less than 2,325 fallen large and sound trees, whilst there are 1,675 dry trees still standing.†"

The sketch map gives the position of the gáds above described, and the following statement shows the order in which the fellings are being carried out in the different gads, the Kangagad, Deotalgad, Kunigad, Dwantigad, Siligad and Jodargad, beginning from the south and working northward: —

Year of felling.	Name of Gád.	
1897—98	Kangagad, Deotalgad and Kunigad.	The Kulni Valley.
1898—99	Kunigad and Dwantigad	
1899—1900	Dwantigad and Siligad.	
1900—01	Siligad and Jodargad.	
1901—02	Jodargad.	

Accordingly in the year 1897, the working of the valley commenced, and the construction of the necessary exports works was taken in hand.

II.—The Export Works.

The key to the working of the Tehri-Garhwal leased forests lies in the River Tons. It is only because timber can be floated down the River Tons to its junction with the Jumna, and on by the Jumna to the different timber markets, that the working of these

† Many over 20 feet in girth, Hon. Fd.

forests is rendered possible. Consequently, in constructing export works to facilitate the extraction of wood from the side valleys there is but one object to be kept in mind, namely, to devise means by which the timber can be cheaply brought down to a point, either in the tributary or in the River Tons itself, whence the material can be left to drift and to find its own way down country, with as little assistance as possible.

In the present case, a reference to the map attached, will show that the main tributary of the Tons is the Mautargad, and it was found that after some blasting had been done, timber could be "telescopically" floated down this stream from a point 6 miles above its junction with the Tons. Above it, as already described, the Mautargad begins to spread out like a fan, the stream dividing into two important branches, the Jakargád, subdividing into the Kangu and Deotalgáds; and the Kunigád, with its side branches the Dwanti and Sili gads,

Experience has proved, as a result of practical experiments carried out during the course of many years in the working of the Bamsu and the Deota Valleys, that provided water is plentiful, wet-slides afford the most useful and the most satisfactory form of transport that can be devised in these hill districts. Consequently, wherever practicable, this form of transport is favoured. In working these valleys it was found that a very satisfactory alignment for a wet-slide could be obtained from the junction of the Dwanti and Siligads, down the Kuni and Mautargads to the point whence floating becomes feasible. On the other hand, owing to the rocky and precipitous nature of the country, the stream itself being interrupted by a series of waterfalls, it was found impracticable to follow up the Jakargad. Consequently, this route had to be abandoned and means had to be devised to bring the timber, extracted from the Kangu and Deotal gáds, round the head of the valley to the Kunigad. For this purpose, a tramway was constructed from the junction of the Deotal and Kangugads, down to the Kulni parao; the timber being thence sent along a wire shoot stretched across the valley to join the wet-slide in the Kunigad.

Subsequently, however, it was found that the working of the wire rope was too slow to take down the number of sleepers required, and an alternative route, consisting of a short length of sledge road and a dry shoot, passing into the wet slide, was constructed, the former on the face of the rocks round the head of the valley, the latter straight down the slope above the Kunigad.

This necessitates changes of method, which should be avoided, if possible, since every change involves a fresh handling and transfer of the material, with corresponding expense, but, on the other hand, on account of the very temporary nature of the works, no great expenditure could be incurred on construction works.

Photo by E. Gleadow, I.F.S.

WET-SLIDE,
About 37° slope.

In each case, the sleepers cut in the higher parts of the different valleys are carried down by coolies to the head works of wet-slide or tramway; and it now only remains to say a few words about the different kinds of works constructed—the wet-slide, the tramway, the wire ropeway, the sledge road and the dry shoot. The drawings will, it is hoped, sufficiently explain the method of construction.

I.—The Wet-Slide.

The following is the description of the wet-slide given by Mr. Gleadow, I. F. S., in his "Notes on the Forest School Tour in Jaunsar, 1898-99."

"At present the wet-slide starts from the Kulni gad depôt and goes down to where the junction of the Yadar* and Kulni gads forms the Mantar gad, but it is intended to prolong its upper end, at least roughly, into the Kulni and other valleys for a considerable distance. The length of the slide in May 1899 was 4,848 feet. The difference of height between top and bottom is 1,100 feet, but 1,100 feet at the lower end are nearly level, so that the slide descends nearly 1,000 feet in 3,748 feet. The gradient varies greatly, being in places as low 5°, but there is a length of 930 feet where the gradient is no less than 35° to 37½°. This is where the slide avoids the cliffs overtopping the Kulni waterfall, itself estimated at 120 feet. Such a gradient is far too steep and necessitates constant attention to the joints and overlaps, but no other course seemed practicable. The defect of so steep a slope is that the first sleeper to go down travels faster than the water, which is consequently spurted out in a fan, leaving the slide almost dry. The next sleeper, not having its speed diminished by the work of emptying the water out of the slide, may run into the first, and one or both be broken or thrown out. It is therefore requisite that the sleepers be put into the slide at considerable intervals in order to avoid collisions, and this means waste of time and loss of efficiency.

"The internal size of the slide is 10" broad and 7" high, which allows sufficient play for a M. G. sleeper without letting much water pass by it. The slide is a little broader at sharp curves, and the sides are made 1" higher. The bottom is a 18" by 4" plank, the sides are 15" by 4", and are wedged up to the bottom by wedges which get their purchase against the ends of the sleepers, the latter having a piece cut out of the middle for the seating of the slide, and wedges. The planks are 10 feet long, of kail, and chir, and the end joints are alternate in sides and bottom. The sleepers are mostly chir, though birch and several other kinds are used. Loss of water by leakage and splashing is made good at three intermediate points only.

*or Jodar.

"In the upper portion of the slide there are five bridges, of which one has a span of about 100 feet, four are between 20 feet and 35 feet, and there are eight smaller bridges, the combined length of the five larger ones being 204 feet. The 100-foot bridge is a single girder bridge formed of two lengths joined in the middle, the joint being strengthened by a 30-foot piece bolted beneath. The deflection due to the weight of this girder was about 4 feet. One end of the girder was pushed over one side of the chasm, and the weight was supported by slings fixed to trees on the cliffs above as the girder was gradually worked across. The girder was prevented from sagging by the slings while two straddle-leg props were inserted, fixed to the ends of the 30-feet middle piece, and settled firmly into the sides of the cliff below. The height of the bridge above the bed of the stream is 80 feet.

"The second girder was more easily got across by the aid of the first.

"The slide will be in use about four years, during which time it will transport 550,000 sleepers, *viz.*, 150,000 brought out by the tramway and wire shoot, and 400,000 from the other valleys."

During the current year 1900, the wet-slide is being extended for a distance of 2,260 feet upstream to the junction of the Sili and Dwanti gads. The gradient of this length of the wet-slide will vary from 10 to 15 degrees, water will be introduced in 3 places, and only a few small bridges will be necessary. The cost of this extension has been estimated at Rs. 2,500, and a saving of Rs. 7,618 over coolie carriage is anticipated.

It has been stated above that wet-slides have been found to give the best results as a means of transport from a higher to a lower level, provided the supply of water is plentiful. Indeed, everything depends on the supply of water, and provided this can be regulated, results are obtained in the working which it may be useful briefly to notice here.

Thus, if a plentiful supply of water be introduced into the wet-slide, the gradient may vary through a very large range; in fact, between 2 and 40 degrees. In the one case, the water acts as a propelling force to push the material along, in the latter case, the water forms a bank in front of the sleeper, checks its velocity and keeps it in the slide.

The actual depth of water which should be maintained in the slide depends not only on the gradient, but on the quality of the wood, the heavier species requiring a greater depth of water. Thus experience would show that with a heavy wood for a minimum gradient of 15 degrees, 3 inches of water depth would be required, and for a minimum of 6 degrees, 4 inches of water. Whereas, with a lighter wood 2 inches of water would be sufficient for a gradient of 5 degrees. The same argument holds good in the

Photo by E. Clayton, L.L.S.

WET SLIDE BRIDGE,

Crossing Chasm 90 ft. wide and 80 ft. deep.

Photo. by R. C. Milward, I.F.S

FOREST TRAMWAY

case of the steepest gradients ; the steeper the gradient, the heavier the wood, the greater must be the quantity of water introduced. This fact was very clearly exemplified in the case of the present slide. The steepest gradient has been made 37° for a length of about 930 feet. At first only a small quantity of water was introduced, with the result that sleepers were continually shooting out of the slide. Now the water has been increased and no sleepers are found to leave the slide.

Experience shows that with this form of slide water should be introduced at least every 1,000 feet. Moreover, it is very necessary to introduce water near the extreme end of the slide. This will not only have the effect of checking those sleepers which are getting to the end of their journey with too great speed, but it will also push on those sleepers which are likely to come to a stop before leaving the slide.

Three other matters also deserve mention—the gradient at the end of the steeper portions, the width of the slide and the curves. As regards the former it is very important to remember that after a very steep length, the gradient should only be reduced very gradually, until it becomes level or nearly so : but under no circumstances should an up-hill length be introduced to check the velocity, as this may cause the descending sleepers to shoot out of the slide.

The width of the slide should also be made only very slightly larger than the width of the pieces to be taken down. In a former slide, constructed in the Deota valley, the trough was made 4 inches wider than the width of the sleepers to be brought down, and the results were not always very satisfactory. In the present case, a play of only 2 inches has been allowed with excellent results.

Lastly, the curve. It is found that almost any curve can be introduced, provided the width of the slide be sufficiently increased where these occur. It is this fact, together with the variety of gradients that can be used and the freedom from accidents to workmen, that renders the wet-slide by far the most satisfactory method of transport in the hills where water is available, especially as compared with tramways and sledge roads. The cost, moreover, compares very favourably with that of the last two mentioned, as may be seen from the figures given lower down.

II.—The Tramway.

The tramway has been constructed for a length of 4,800 feet from the junction of the Deothal and Kangu Gads to the Kulni parao, and there taps the material coming from the heads of the former valleys. The ground for the construction of the road on which the line is laid is fairly good Five bridges had to be constructed, one fairly large consisting of 3 spans, respectively, 25, 31

and 30 feet in length. The gradient of the line varies from 4 to 6 degrees in the upper 1,300 feet, and from one-half to *nil* degrees in the lower 3,500 feet.

The gauge is 2 feet, and the rails are made of moru oak scantlings 10 feet long by 5 inch by 3 inches, unless shorter lengths are required on account of curves. These are notched into sleepers, placed 5 feet apart, made of any kind of wood that was handy. The tramway is only to be used for the carriage of some 150,000 sleepers, and consequently it was hoped that the wooden rails would not wear down before the export work was completed.

Over these rails four-wheeled iron trucks are run, capable of carrying 28 to 32 metre gauge sleepers at a journey. They are wheeled by three men, one in front and two behind.

The tramway will only be in use for a short time, the quantity of material to be carried over it being small, consequently only a very rough and economical method of construction could be adopted. The gradients are therefore too steep in the upper part and too level in the lower, and some of the curves are too sharp. The whole cost of the work came to Rs. 2,978, and a saving of Rs. 5,056 is estimated over coolie carriage wages.

III.—The Wire Ropeway.

On reaching the Kulni parao by the tramway, the trucks are unloaded and the sleepers stacked. They can then proceed on their journey to the wet slide either by the sledge road and dry shoot route, or by the inclined wire rope-way.

The wire shoot is about 1,300 feet in length, and descends 400 feet across a deep valley. It consists of a single fixed steel wire rope with hemp core, $1\frac{3}{4}$ inch round, weighing 3 lbs. per fathom. Its breaking strain is $8\frac{1}{2}$ tons, but the safe working strain is one-eighth of this. It costs 91 shillings per cwt. This wire carries the whole weight of the sleeper, which is simply hooked on to it by means of a pulley-hook and allowed to slide down, until it is brought to rest by striking against a soft earthen bank. At the top and bottom of the shoot are two stout headstocks of chir pine let into the ground and strongly braced. The upper part of each headstock holds fast the fixed wire-rope, which is further held by being taken round a tree at the rear: the lower one, moreover, has been buried in the ground to form a bank against which the descending sleeper may strike. The erection of this shoot was a fine bit of work not without difficulty and danger, and the getting out of 1,300 feet of steel rope weighing 650 lbs. over precipitous ground without accident reflects great credit on the officer in charge.

This mode of transport has not been very successful, chiefly on account of its slowness; and it is on this account that an alternative route had to be devised. At the present time it is found that only some 500 sleepers a day can be sent down.

Again, sleepers, owing to their swinging, are occasionally found to stick in the middle, and a violent shaking of the rope has to be resorted to before the sleeper can be made to move. The empty pulleys are carried up by boys from the foot of the wire rope-way to the top; and the sleepers on being landed are put into the wet slide and sent down to the Mautar Gad.

IV.—The Sledge Road.

The Sledge Road is cut out of the face of the rock for a length of 600 feet. It is constructed of two rows of longitudinal beams, 10 to 12 feet long, 4½ inches by 4 inches, and placed 34 inches apart. On to these beams are notched cross pieces 5 feet by 4 inches by 4 inches placed 24 inches to 33 inches apart, according to the slope. In these cross pieces which are made of rejected deodar sleepers, are cut the slots which serve as guides for the sledges. The slots are ½ inch deep, from 6 inches to 7 inches wide, and 30 inches apart from centre to centre. The cross pieces besides being notched are also fastened by moru oak trenails. Along the steeper portions of the sledge road on the outside of the notches are notched and nailed wooden scantlings 6 to 10 feet long, and 4 by 3 inches, in order to prevent the sledges from bumping off the sledge road, over the face of the rocks into the abyss below.

The sledges consist of two runners made of seasoned moru oak placed 20 inches apart, connected by two to three wooden struts and carrying 6 uprights, and two handles. The runners are 9 feet by 5 inches by 1¾ inches, and when they are worn down to 2 inches they are re-soled with pieces of moru oak. One sledge costs about Rs. 10, carries 20 M. G. sleepers, and is worked by two men.

This sledge road had to be constructed quickly, roughly and economically, and consequently, very little attention could be paid to suitable gradients. The result is that a great portion of the way is far too steep and even dangerous; so much so that in traversing the last length of 350 feet the sledge is let go and allowed to descend by itself, as it would be dangerous for the men to try to check or to guide it. The first 250 feet of the sledge road has a gradient varying from 4 to 13 degrees, and up to this point the loaded sledge is brought down by two men. Beyond this point the gradient increases to 22 degrees and the sledge is allowed to run down by itself and the impetus which it obtains enables it to reach the end of the road-way, the gradient; gradually decreasing to 18, 12, 10 and 2 degrees at the end.

Here the sledges are unloaded, and the sleepers are sent down the dry slide, which passes into the wet slide.

V.—THE DRY SLIDE.

The dry slide is 250 feet in length, and is constructed in exactly the same manner as the wet slide. The gradient is 26 degrees at the top and varies through 30, 28 and 25 degrees, until it is reduced to 10 degrees at the lower end, where it curves round and passes into the wet slide.

These gradients work fairly satisfactorily in dry weather, only a few sleepers being found to stop towards the end, but in very wet weather work has to be suspended.

VI.—FINANCIAL RESULTS OF THE WORKINGS.

The results of working the Tramway, the Sledge-road the Dry slide, the Inclined Wire Rope-way, and the Wet slide up to the end of April 1900 may be gathered from the following figures :

I. THE TRAMWAY.—Length 5,324 feet.	Rs.	A.	P.
Capital Cost of construction. ...	1,484	0	0
Repairs to roads, to trucks, and carriage of 126,863 M. G sleepers and 3,390 scantlings, @ Rs. 0 3-6 per load of 28. ...	1,494	1	10
Total ...	2,978	1	10
Cost of carriage of above number of sleepers by coolies @ 1 anna and 6 pies per M. G. sleeper and scantling respectively. ...	8,034	14	0
Saving in favour of Tramway. ...	5,056	12	2

II. THE SLEDGE ROAD AND DRY SLIDE.—Length 600 + 550 feet.			
Capital cost of construction. ...	177	0	0
Cost of repairs and of sledging 89,745 M. G. sleepers and 3,390 scantlings, @ 1 anna per load of 15.	429	12	4
Total ...	606	12	4
Estimated cost of coolie carriage for above number of scantlings, @ 3 pies per piece	1,455	3	9
Saving effected by sledge road and dry shoot.	848	7	5

III. THE WIRE ROPE-WAY.—Length 1,400 feet span.			
Capital cost of construction.	600	0	0
Making pulley-carriers and cost of exporting 24,650 M. G. sleepers.	177	3	0
Total ..	777	3	0
Estimated cost by coolie carriage. ...	770	5	0
Loss against Wire Rope-way. ...	6	14	0

IV. THE WET SLIDE.—Length 4,818 feet.

Capital cost of construction. ...	4,924	0	0
Cost of repairs and siding 3,550 B. G., 1,27,590 M. G. and 3,360 scantlings. ...	1,303	4	8
Total ...	6,227	4	8
Estimated cost of export of above by coolie carriage.	14,296	1	0
Saving in favour of Wet slide. ...	8,068	12	4

Note.—About 400,000 sleepers remain to be brought down by the Wet slide, so that the ultimate saving in favour of the Wet Slide will be considerably greater.

IV.—SUMMARY.

The total savings obtained by the construction of the Kulni export works calculated up to 30th April 1900 are as follows :—

	Rs.	A.	P.
Tramway.	5,056	12	2
Sledge Road and Dry Shoot.	848	7	5
Wet slide.	8,068	12	4
Total ...	13,973	15	11
Deduct loss by Wire Rope-way. ...	6	14	0
Grand Total Saving Rs. ...	13,967	1	11

The grand total saving to date thus amounts to Rs. 13,967, and to this must be added the avoidance of several difficulties such as the impossibility of obtaining sufficient coolie labour, the trouble of feeding and housing and supervising the vast numbers of coolies that would have been required, the construction of export paths, &c.

Thus the Kulni Export Works most thoroughly justify their existence. They are both useful and interesting, and reflect the greatest credit on all officers concerned. Praise, however, must not only be given to those officers who have actually carried out these particular works; it is due even to a greater extent to those officers who originally planned and engineered and proved the expediency of such works in Jaunsar. Special mention must, however, be made of Pandit Rama Dutt, Extra Assistant Conservator, the Officer at present in charge and directly responsible for the carrying out of the works above described.

In conclusion, a word to those of our readers who may be contemplating a short spell of rest in the Himalayas. To all such we would strongly recommend a trip to Jaunsar and its export works. Both in the hot weather and in the autumn, the weather in Jaunsar is perfection; the pine-clad hills are most pleasant, the

sylvicultural and forestry questions that may be studied in these forests cannot fail to interest the most jaded forest officer; and last but not least a certain amount of *shikar* is to be had, particularly among the pheasants in the autumn.

A New Burmese Timber-Tree.

Among the many specimens kindly sent to the Calcutta Herbarium by Officers of the Forest Department at the desire of the Inspector-General, in connection with an enquiry into the source of Padouk and the distribution of the various Indian species of *Pterocarpus*,—an enquiry still uncompleted because all the necessary material has not yet come to hand—the most interesting happens not to belong to *Pterocarpus* at all. Like many of the other specimens sent, these are unfortunately incomplete; they have no flowers, and the leaves and fruit sent are not attached. They were collected in Tenasserim by Mr. Hearsey, and forwarded by Mr. Manson. There is, however, no doubt as to the genus to which Mr. Hearsey's fruit belongs, and the leaves, though somewhat different from the leaves of previously known species of that genus, are sufficiently like these to make it hardly doubtful that they belong to the tree with whose fruit Mr. Hearsey has associated them.

The genus to which the fruit belongs is the Leguminous genus *Pahudia* Miq., founded by its author on a Javanese timber-tree, *P. javanica* Miq. (*Flor. Ind. Bat.* I. pt 1, 85 [1855]), first collected in Java by Horsfield, and excellently characterised in its original definition. Miquel, as an afterthought, added a second species in the same work (p. 1080), *P. Hasskarliana*, based on the description given by Hasskarl (*Retzia* I. 199) of *Jonesia monopetala*. To provide room for this species Miquel had to modify his original diagnosis very considerably; so considerably, in fact, that Bentham (*Genera Plantarum* I. 580 [1865]) has not admitted it in the genus, and Kurz (*Journ. As. Soc. Beng* xlv pt. 2, 290 [1876]) has had to point out that it cannot be congeneric with the original *Pahudia*. From the description given of its pod, Kurz would refer *P. Hasskarliana* to the genus *Macrolobium*; Koorders and Valeton, however, believe and in all probability correctly (*Bijdr.* pt. 2, 27 [1895]), that it is only *Afzelia Bijuga* A. Gray. At the same time, however, Koorders and Valeton suggest that the species known as *Afzelia coriacea* Bak. (*Intsia coriacea* Maing.; O. Kuntze) be referred here. They are undoubtedly correct in their belief that this species cannot possibly belong to the genus in which Baker and Kuntze wish to place it. It is not, however, a *Pahudia* any more than it is an *Afzelia* (*Intsia*), but is a *Sindora* (*Galedupa*).

Baillon (*Histoire des Plantes* II. 112 [1869]) would include *Pahudia* as a whole in *Afzelia* (*Intsia*): the pod and seed are, however, so different from those of the Indian *Afzelias** that this character, added to the distinctive one obtainable from the stamens —monadelphous in *Pahudia*, free in *Afzelia* (*Intsia*)—renders it more convenient to recognise *Pahudia* as a genus apart. Taubert, in Engler's *Naturlichen Pflanzenfamilien* III., pt. 3, 141 [1894], omits to notice that *P. Hasskarliana* cannot belong to the genus, or to notice the still more important fact that there *is* really another species, *P. xylocarpa* Kurz (*Journ As. Soc. Beng.* xlv, pt. 2, 290 [1876]), founded on specimens collected by Teijsmann in Siam. Kurz had the forethought to provide Forest Officers with an account of this species (*Forest Flora, British Burma* I 413 [1877])—a forethought now wholly justified, because the tree has recently been found in the Southern Shan States. It is remarkable that, like Taubert, Koorders and Valeton have also overlooked the existence of this Siamese species.

In Mr. Hearsey's tree, which, from his account of it, must be a very fine one, we have now a third species of *Pahudia*. He speaks of it as having a trunk 10 feet in girth, capable of yielding planks 20 feet long. The Burmese name for the tree is Pyin Padouk, but, as Mr. Hearsey says, "it is neither the one nor the other." The fresh seeds are worn as necklaces by the wild Siamese on the frontier.

As the genus finds no place in the *Flora of British India*, one has to turn to Kurz's generic description in the *Forest Flora*, which is excellent. As Kurz's work is accessible to all Burmese Forest Officers, it is not necessary here to do more than give a brief diagnosis of the genus, with a key to the species and a note of their hitherto recorded localities.

PAHUDIA *Miq.*

Erect unarmed timber-trees; leaves even-pinnate, leaflets few, papery; flowers remose or panicled; calyx 4-partite, lobes decussate imbricate; petal solitary; stamens monadephous in a slit sheath, filaments 7 free above with 2 small staminodes at base of sheath; ovary stipitate; pod large, oblong, thickly woody, 2-valved, septate and spongily pulpy within; seeds with a large, basal, strophiolate or arillate tunicle.

*The African species on which the genus *Afzelia* was originally founded by Smith (*Trans. Linn. Soc.* iv. 221 [1798]) which though included in *Intsia* by Taubert, is still admittedly the type of a distinct section *Afrointsia*, has a pod and seed quite like those of *Pahudia* and differs only in having three petals (two of them quite small) and in having free instead of united filaments. My own belief is that the union of *Afzelia* and *Intsia* is quite uncalled for, and that if any rearrangement is required it ought to take the form of a fusion of the genuine *Afzelia* with *Pahudia* and perhaps the association of both with *Sindora*, which is the true *Galedupa*. This, however, would involve such an alteration of names in the group to which all of them belong that I do not care to insist on the measure in this note.

Key to the species.

Arillate funicle prolonged upwards on the front and back of the seed; seed slightly compressed antero-posteriorly so that the longer transverse axis lies across the pod; leaflets 4-5-jugate, subequal-sided, ovate or oblong, base rounded or slightly cordate; somewhat puberulous, not glaucous beneath ... *javanica.*

Arillate funicle with a horizontal edge, not prolonged upwards on the front and back of the seed; leaflets quite glabrous, glaucescent beneath :—

Seed slightly compressed antero-posteriorly so that the longer transverse axis lies across the pod; leaflets 4-jugate, obovate or oblong, unequal-sided, base cuneate or rounded ... ... *martabanica.*

Seed much compressed laterally, so that the shorter transverse axis lies across the pod; leaflets 2-3, rarely 4-jugate, wide ovate, subequal-sided, base rounded or slightly cordate ... ... *xylocarpa.*

1. Pahudia javanica *Miq. Flor. Ind. Bat.* I. 1, 86 (1855); *Kurz, Journ. As. Soc. Beng.* xlv. 2, 289 (1876); *Koord. and Valet. Bijdr.* II. 28 (1895).

MALAY ARCHIPELAGO; Java. *Horsfield! Koorders!*

Leaflets 4-8 cm. long, 2·5—4·5 cm. wide; *pod* 7·5—13 cm. long, 6-7 cm. wide, 4 cm. thick, 3-8-seeded; *seeds* 28-33 mm. long, 13 mm. wide, 16-22 mm. thick.

2. Pahudia martabanica, *Prain.*

INDO-CHINA; on the Tenasserim river, between Sinbyadine and Aungthawara, *Hearsey!*

Leaflets 10-12 cm. long, 6-7 cm. wide; *pod* 20 cm. long, 8·5 cm. wide, 5 cm. thick, 8-10-seeded; *seeds* 36-40 mm. long, 16-18 mm. wide, 17-22 mm. thick.

As regards its foliage this approaches most nearly to *P. xylocarpa*, the leaflets being quite glabrous and glaucescent beneath; in shape, however, the leaflets are unlike those of either of the other species. Its pod is larger than in either of other species, and its seeds, while they approach most closely those of *P. javanica* in shape, differ from these as regards the funicle, which is very like that of the seeds of *P. xylocarpa.*

3. Pahudia xylocarpa, *Kurz, Journ. As. Soc. Beng.* xlv. 2, 290 (1876); *Kurz. For. Flor. Brit. Burma,* I. 413 (1877); *Prain, Journ. As. Soc. Beng.* lxvi. 2, 494 (1897).

INDO-CHINA; Siam, *Teysmann!* Southern Shan Hills, *King's Collector!*

Leaflets 7-8 cm. long, 5-6 cm. wide; *pod* 10-12 cm. long, 6-7 cm. wide, 4 cm. thick, 2-3-seeded; *seeds* 33 mm. long, 25 mm. wide, 15 mm. thick.

The laterally compressed seeds at once distinguish this from the other two species.

D. PRAIN.

Notes on India Rubber.

Mr. J. Parkin, M. A., of the Ceylon Royal Botanic Gardens, has been engaged in carrying out scientific investigations upon rubber, its origin, flow in different species of trees, composition, coagulation, &c., and the chief conclusions which have been arrived at by him as a result of his experiments have been embodied in a Circular, Series I.—Nos 12, 13, 14, of June 1899, issued by the Royal Botanic Gardens, Ceylon.* These conclusions, though many are still in an experimental stage, are nevertheless of such importance that it is well to draw attention to them especially now that the production of India-rubber is receiving so much attention from the Forest Department in this country, notably in Assam and latterly in Burma.

Before proceeding to the giving of details and conclusions of work recently carried on in the Island of Ceylon, it will be well perhaps to make a few remarks on the chemical and physical features of latex, and on the structure and general arrangement of the tubes that hold it, with special reference to the economic lactiferous trees.

"The milky juice, technically known as *latex*, which exudes from certain plants when wounded, is quite distinct from the so-called "sap" of plants. It is contained in special tubes running for the most part longitudinally in the outer tissues of the plant, and forming usually a connected and closed system. This lactiferous system or tissue is an additional development in a comparatively few families of flowering plants, and although not altogether absent in the vegetation of temperate regions, it is markedly characteristic of tropical floras. The natural orders Euphorbiaceæ, Moraceæ, Apocynaceæ and Asclepiadaceæ, chiefly tropical, are especially lactiferous, and it is the first three that have so far furnished commercial rubber yielding trees. The small order Sapotaceæ contains the trees which supply guttapercha, indigenous and almost peculiar to the Malay Peninsula and Archipelago."

This milky juice or latex consists, as a rule, of globules of resin. caoutchouc, gutta, wax, &c., suspended in a watery medium, water containing various substances in solution, such as, albuminous matter (proteids); salts, usually organic acids; phosphates; tannin, characteristic of some latices; and generally small quantities of sugar.

"The laticiferous system is usually distributed throughout the organs of a plant, present alike in the stems, leaves, roots and fruits, and is formed at a very early stage in the developing organs, so that some time ere the part is mature copious milk is seen to exude from a wound. The tubes originate in two distinct ways according to the kind of plant

*Caoutchouc or Indian-Rubber. Its origin, collection, and preparation for the market, &c. Circular No. 12, Royal Botanic Gardens, Ceylon, June 1899.

"In one case exhibited by Hevea and Manihot the laticiferous vessels arise from series of sacs (cells) arranged for the most part longitudinally. The separating walls (septa) between the contiguous cells break down, the original protoplasmic contents transform into or rather secrete the latex, and the result is a number of communicating tubes full of a milky fluid. The more complete the dissolution of the intervening partitions between the originally separate elements, the more perfect is this form of laticiferous system, and the better the flow of latex from an incision. This, of course, is an important practical point. In gutta trees the laticiferous sacs, although they lengthen considerably, never communicate one with another; hence the difficulty of extracting the latex in quantity. The whole trunk has to be cut all over, thus sacrificing the tree, in order to obtain the guttapercha.

"The other type of laticiferous tissue is that shown by *Castilloa, Ficus, Euphorbia, &c.*; in fact, it is characteristic of the orders Moraceæ, Apocynaceæ, and part of the Euphorbiaceæ, the other part possessing the articulate system as it is called, which has just been briefly described. Instead of the laticiferous tubes arising *de novo* in the growing organs, the tubes present in the mature parts send branches into them. In fact, it has been established for several of these plants that the laticiferous system is laid down once for all in the seed in the form of a certain number of initial cells. Each of these commences branching in definite directions and keeps pace with the growth of the plant. Consequently this kind of system is thoroughly intercommunicative from the commencement and remains so. Hence as a connected system this is more perfect than the other, and the latex flows as a rule more freely from such plants. This may partly account for the much better yield of latex from an incision in the bark of Castilloa than in that of Hevea or Manihot.

"The laticiferous system in the stem, the part of the plant of importance for rubber production, occupies definite positions. In the stem bearing leaves the laticiferous ducts are situated as a rule in *greatest abundance just without the vascular cylinder*, the part between the pith and the external soft portion, the cortex. A lesser development may occur just within the outermost limiting layer of cells communicating with the former at the nodes—*i.e.*, *the points where leaves are attached to the stem*. There may also be a third development in the pith, very noticeable in such climbers as Landolphia. The first, however, is the important one to consider here.

"*In laticiferous trees the laticiferous tubes continue to* appear in each fresh addition to the bast by the cambium. Consequently the newest tubes are situated in the innermost part of the bast next the undifferentiated active layer of cells, the cambium. *In Hevea and Manihot the tubes arise afresh from*

certain longitudinal rows of cambial cells, in the same way as they do during primary growth; whereas in Castilloa, new branches are given off from the old and outer tubes, which penetrate and ramify through the new bast. The laticiferous ducts as they are pushed outwards by the growth of the stem become crushed and dried up, so that the flow of latex from them is diminished or stopped. It is the last-formed ducts—*i.e.*, the innermost—that flow freest when wounded. An incision must then extend as far as the cambium, in order that the latex may exude plentifully, but it must not extend into the wood, else the wound will be liable not to heal completely."

A number of caoutchouc yielding plants have been grown in the Ceylon Botanical Gardens at Peradeniya and Henaratgoda, namely: –

1. Hevea brasiliensis (The Para-rubber) N. O. Euphorbiaceæ.
2. Castilloa elastica (Central American or Panama, N. O. Urticaceæ.)
3. Manihot Glaziovii (The Ceara-rubber tree, N. O. Euphorbiaceæ)
4. Urceola esculenta (N. O. Apocynaceæ), native of Burma.
5. Landolphia Kirkii (N. O. Apocynaceæ). The best rubber climber of Africa.
6. Landolphia florida, (N. O. Apocynaceæ.) The latex from it flows freely, but does not yield true caoutchouc.
7. Landolphia Hendelotii (N. O. Apocynaceæ), native of Eastern Africa and yields a viscous latex.
8. Tabernæmontana crassa (Apocynaceæ). The latex flows freely from this West Africa tree, but produces only a sticky substance and not true caoutchouc.
9. Sapium biglandulosum (N. O. Euphorbiaceæ). This tree is recognized as producing a valuable rubber at elevations of 6 000 to 8,000 feet in Columbia.
10. Ficus Vogelii (N. O. Moraceæ). Natural habitat—West coast of Africa

A certain number of notes have been collected about each of the abovementioned trees: but Mr. Parkin's experiments relate almost exclusively to the first three, namely, the Para and the Ceara rubber trees, and Castilloa. His investigations, moreover, may be classed under two heads, A.–The extraction of Latex, and B.—The preparation of Commercial rubber from the Latex; these questions being again studied under the following sub-heads:—

A.—The Extraction of Latex

(1) Kind of Incision.

(2) Instrument to use.

II. –Collection of Latex from Incisions.

III.—Area of trunk to be tapped.

IV. –Effect of wounding on flow of latex.

I.—Incision—

B.—The preparation of Commercial rubber from the Latex,

A.—The Extraction of Latex.

In a Rubber tree the lactiferous vessels occur throughout the plant, being present in root, leaves, and young fruit, as well as in the stem, and appearing also in the new bast which arises through the secondary thickening of stems and roots. Consequently it is natural in the first place to inquire which is the best part of the plant from which to extract the latex for the preparation of rubber. In a few lactiferous trees, the main trunk and branches exude no latex when wounded, only the leaves and twigs being lactiferous. In other rubber plants again, a herbaceous plant quite recently discovered in Africa, it is only the thick underground stem that is full of latex.

But even apart from these exceptional cases, the question is one of great importance. The main trunk or branches are naturally the most suitable to the native collecting it from already grown forest trees or climbers, but with cultivators the need of waiting several years, at least six in the case of Castilloa and ten in that of Hevea, before the trunks of the trees are fit for tapping is a serious item Consequently it is a question well worthy of consideration whether any other part of the plant could be made to yield rubber of good quality and in sufficient quantity to pay the cost of extraction.

In the case of such trees as Castilloa or Hevea, besides the trunk and main branches, the only other parts which might be used for the extraction of rubber are the young shoots. If these could be used profitably, then a return on the capital could be obtained in a year, either by growing crops of seedlings or by coppicing permanent plants.* This question received considerable attention in Ceylon, but unfortunately, with no encouraging results, and "in our opinion it seems hardly likely, at any rate as far as Ceylon is concerned, that rubber can be extracted profitably from the leaves, twigs, &c." It remains, therefore, merely to consider the best means of extracting the latex from the main stem.

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*"The following paragraph reproduced from an article in the *India rubber World*, on some recent developments in rubber cultivation, bears on this question:—"The most interesting point under discussion in relation to rubber-planting in the British West Indies is a series of experiments now being carried on in London and Trinidad, by which it is proposed to secure rubber from year—old trees of *Castilloa elastica*. It has been found that seeds sown broadcast over a prepared field will yield an abundant crop of young trees, which at about a year old can be cut and sent to a factory, where, with ordinary machinery operating a simple process, 8 per cent. of fine rubber can be extracted from the young shoots. This can be done in the laboratory. It is claimed that the process is a simple one, that but little machine is necessary, and that in future the world's rubber supply will be secured from an annual crop of young tree sown on cultivated estates and not from remote forests as at present. A series of experiments has shown that the young tree contains about 8 per cent. of rubber, which would, at present prises, return an estimated profit of $200 to $400 per acre. The extraction of rubber from young shoots has been accomplished chemically in the laboratory, but whether it can be applied to the economic production of rubber on a large scale remains to be seen."

I.—Incision.

Two chief points come up for consideration here, *viz*, the kind of incision, and the instrument with which to make it.

(1) Kind of Incision.—In order to obtain the latex from the trunk of a rubber tree the lactiferous ducts have to be cut in some way or other. The question naturally arises as to what is the best kind of wound to make in order to extract the maximum amount of latex with the minimum of injury to the tree.

Accordingly 5 different experiments were undertaken in order to determine the amount of latex collected from vertical, horizontal, oblique, V—shaped, and X—shaped incisions (I, –, I, V, X). It is not necessary here to enter into the details of the experiments as carried out It will be sufficient merely to quote the conclusions arrived at which were as follows:—

1. The oblique incision yields about double that of a vertical or horizontal incision, but there is little difference between the amount collectable from a vertical and horizontal incision.

2. If the tree runs well, say 5 C C. per oblique incision, then very little more latex is obtained by doubling the incision in the form of a V ; whereas if the flow is poor then a V gives about double that of a single oblique cut.

3. One objection to the V—shaped incision is the liability of loosening the piece of bark it encloses when the second half is made ; this loosening is apt to retard the healing of the wound or even to prevent in some cases a complete cicatrization. To obviate this an X incision was tried ; but the Vs were found to give nearly double the yield of the Xs.

In conclusion therefore there seems little doubt that the V form of cut is the best.

(2).—Instrument with which to make the incision.—For this purpose experiments were tried with a variety of different instruments, such as an ordinary carpenter's chisel and mallet, a sort of a hatchet with a wedge—shaped blade about $1\frac{1}{2}$ inches in width, stone and cold chisels, and the conclusions arrived at are quoted below:—

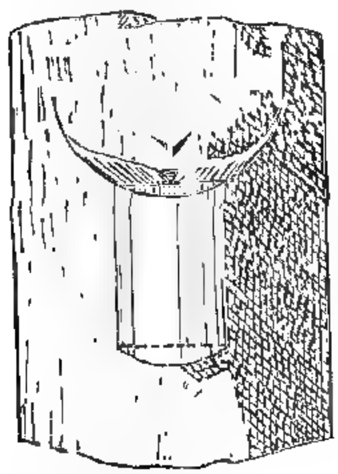
"We should be inclined, on the whole, to recommend an ordinary carpenter's chisel (or perhaps better a wedge-shaped chisel) with a thickness of $\frac{3}{16}$ to $\frac{1}{4}$ inch (5 to 6 mm.) at a distance of $\frac{1}{2}$ inch (13 mm.) from the cutting edge. The breadth of the chisel may vary from 1 to $1\frac{1}{2}$ inch (25 to 37mm.). It seems hardly necessary to have a chisel with a guard, for the bark varies somewhat in thickness, both with respect to the age of the tree and to the height on the trunk. Unless the guard were movable, the chisel being naturally always driven in up to the stopping place, would sometimes penetrate the wood, if the

bark happened to be thinner than usual, and if thicker might not reach the innermost milk ducts—the ones which flow the freest. With care and a little practice the chisel and mallet can be used so as just to reach the cambium and no further. The blows *should be lightly dealt and stopped as soon as any increase of* resistance is felt.

II.—THE COLLECTION OF THE LATEX FROM THE INCISION.

This question has been receiving considerable attention chiefly because the method hitherto employed for collecting the latex has been very faulty in several respects. Under this method, a mud gutter is formed around the base of the tree, and the streams of latex flowing from the V incisions made in vertical rows reach this gutter and ultimately collect in cocoanut shells stuck here and there under spouts made in the mud. As a result a quantity of latex dries on the tree, often as much as half; the latex collected is apt to be contaminated with dirt of all kinds and on this account it takes a long time to dry, so as to form rubber, and during the drying it putrifies and becomes mouldy, giving off a sickening smell. The best plan then is to collect in a separate vessel, the latex exuding from each incision, and the following plan has been devised:—

"We have devised a small tin vessel, which seems to answer very well, and it can be made at a cheap rate and is light in weight. It is half cylindrical in shape (see figure), 2 inches (5 cm.) long, by about 1 inch (2·5 cm.) broad. Near the tops of the flat side a small spike is soldered in, which projects about $\frac{3}{16}$ inch (5 mm.) outwards. The tin holds about 30 c.c.; as far as our experience goes of yield of Hevea trees in Ceylon, the tin might easily be made a third less in size. *The tin is fixed on* the bark by pressing in the spike with the thumb. To prevent the latex from trickling down between the bark and the tin, some plastic material is needed to lute the upper edge of the tin to the bark. Fine clay will do, but it is open to the two following objections. As it contains water the latex is apt to suffuse over



—Front View.—

and soak into it, and as it soon dries and cracks the tins cannot well be fixed some time before hand. Putty overcomes the first objection, but not the second. We found in the laboratory at Peradeniya a greenish putty-like substance, which does not

harden, but is permanently plastic and readily moulds like soft wax into any shape required.*

"This is a very satisfactory material, and can be used over and over again if care is taken to remove the small amount of rubber which dries upon it at each incision. A little of it is rolled between the palms of the hands into a "worm;" this is stuck to the bark in the form of a curve, with the concave side uppermost. The spike of the tin is pressed into the middle of this, and then with the finger the plastic material is pressed down so as to form a smooth surface over which the latex will run. The two ends of the worm are turned up as a safeguard in case the latex should trickle from other points besides the lower end of the incision. A lid is put over the mouth of the tin and the incision made just above, and then the lid removed. The lid prevents the particles of outer bark, which fly off as the incision is being made, from falling into the tin.

"For Castilloa a tin of the same pattern has been used, but about three times the size (100 c. c. capacity) and with a stouter and longer ($\frac{3}{8}$ in.) spike, necessary for pressing into the harder outer bark and for supporting a greater weight. The tins can be fixed some time beforehand. Since tapping is best performed in the early morning, the tins can be luted on the previous evening. For this reason it is perhaps best to have each tin provided with a lid, so as to keep out dirt or rain. The lid should have no downward projection on the straight side, so that it can be easly slipped on and off.

"In the case of Hevea, a little water should be put into each tin to prevent any of the latex from drying. If the flow is copious, such as 10 c. c. per incission or more, then the water may be unnecessary. In applying this method of collecting the latex to trees which exude very poorly, we have found that the small quantity of latex which flows into the tin floats on the surface of the water, and is very liable to form a clot. Stirring prevents the clotting, but this entails extra labour. A better plan is to use slightly ammoniated water; this has been found to prevent as a rule any spontaneous clotting. About one part by volume of the ordinary solution of ammonia in 100 parts of water is ample. It is best to add to each tin the same amount of liquid. A little vessel, such as a small glass tube which holds 5 c. c. or under, is convenient. This is filled with the ammoniated water for each tin and emptied into it. When the wounds have ceased trickling, which varies greatly according to the state of the

*This substance is said to be of local manufacture, but I have been quite unable to find out its composition or find any one who knows where it was made.—J. C. C. W.

trees—sometimes only a few minutes, at other times as long as an hour—the tins are detached one by one, stirred, and their contents emptied into a large receiving vessel through a coarse cloth sieve fastened over the mouth; this filters out any particles of bark or other foreign matter which may have fallen into the tins. Each tin can be rinsed out with a little water, and the rinsings added to the rest of the diluted latex, which after another filtering is ready for the extraction of its rubber.

"In the case of Castilloa it is not necessary to add first a little water to each tin. The latex has no tendency to clot. The caoutchouc particles, being much larger than those in Hevea, seggregate from the liquid part, which in contact with the air rapidly darkens to a beer-like fluid. The latex as it first flows out is quite white, but, owing to the formation of a dark soluble colouring matter by means of the fixation of the oxygen from the air, it rapidly becomes of a dirty brown colour. Usually the flow at first from an incision is rapid, but owing to the seggregation of the caoutchouc globules the liquid part of the latex is apt to leave some of the solid particles behind, so that the wound becomes covered with a mess of thick creamy latex. This should be drawn down into the tin, when the latex has ceased to flow. The latex from all the tins is collected together and the washings added, and the whole passed through a sieve to free it of pieces of bark, &c. A metal sieve, such as is used for milk, answers better than a cloth one for Castilloa The latex should be brought to a dilution of about five times with water, and is then ready for the extraction of its rubber by creaming, which is discussed further on."

III.—The Area of the Trunk to be Tapped.

Two points claim consideration here, namely—what extent of the bark of a tree should be tapped at one time; and how far apart should the incisions be made?

The answer to these questions appears to depend a great deal upon the species of the tree in question. Thus, in the case of Hevea, the incisions can be made at one time from six inches to a foot (45 cm. to 90 cm.) apart. On the other hand, in the case of Castilloa where the outflow is much greater than in Hevea, and an incision will drain a much larger area of the laticiferous system, experiments show the advisability of having the incision at a good distance apart. "One incision draws latex from a large area of bark although it does not completely drain it and the extra amount of labour and injury to the tree entailed by placing tins and making incisions closely together on the trunk of a Castilloa is not repaid by the small amount of additional latex obtained."

Again, since the tins may be put on very sparsely, it is little trouble tapping the main trunk thoughout its total length and even some of the main branches; whereas in the case of Hevea it is very different. It may be concluded that there is a greater exudation of latex from wounds made at the base of the trunks of Hevea trees than at any higher region: that the exudations from one to five or six feet up the trunk differ little: and that above five or six feet the latex exuded falls off very considerably. Thus the base of the tree should not be neglected in tapping, and it seems barely worth while to carry the incisions up the trunk above six feet. In any case the tapping should be performed in a systematic manner.

IV.—THE EFFECT OF WOUNDING ON THE FLOW OF LATEX.

"A large number of experiments on different methods of tapping have been made and are still being made in the Botanic Gardens, and their results will be published later. Those planters who are beginning to tap their trees might well repeat some of the experiments described above on a larger scale. The success or failure of the cultivation depends chiefly on the yield of milk, and it has been clearly shown that this is extraordinarily different in different trees of the same size and age, and that it may be enormously affected by different methods of treatment. Each man must find out for himself the method absolutely best suited to his trees, in the light of the above observations and of his own and those of other workers."

One thing, however, appears to be certain, namely, that the effect of wounding is to very largely increase the output of latex from the area around it. One example will be sufficient to prove this. Between the 25th March and the 6th June 1899, 280 incisions altogether were made in four Hevea trees in the course of 14 tappings, working from above downwards, and the same from below upwards. As a result the total output rose from 61 c.c. at the first tapping to a maximum of 290 c.c. at the sixth, and then slowly fell off until the two series of wounds met and crossed at the eigth tapping; after this the yield slowly increased again to a second and higher maximum of 499 c.c., perhaps from the effect of the old wounds upon the new tappings made on the opposite side of the tree.

"The great thing is to use the "wound effect" by making new wounds near the old after an interval of say six or seven days. The old wound may be "renewed" with a knife several times, and a good yield is obtained thus, but the final result is liable to be a very ugly wound in the tree, which may lead to decay or other injury.

"We do not yet know the conditions under which this "wound reaction" works, and it is probable that much will yet be found out about it: probably it will be found that under some conditions it is best to tap daily, while under others it is best to tap at intervals of two, three, four, seven, or even ten or twelve days."

B.—The Preparation of Commercial Rubber from the Extracted Latex.

Numerous experiments have been carried out to determine the best method of extracting the rubber from the latex, specially with a view of superceding the very unsatisfactory and wasteful methods, which have been employed up to date. According to the old procedure, the latex was merely allowed to dry to form rubber with the results that previous to drying for various reasons, the latex putrified giving off a most offensive smell, and when solid became covered with mould; and moreover, a long time is necessary before these cakes become thoroughly dry.

Putrifaction, mould, and moisture are what manufacturers greatly object to in rubber, and consequently the two chief points with respect to the preparation of commercial rubber are to have it free from moisture and putrefaction. The first can be effected by drying the rubber particles in thin sheets; the second, by either removing the proteid matter or by the addition of some antiseptic substance which prevents the growth of bacteria and mould. With this object in view 5 different experiments were undertaken by Mr. Parkin, *viz* :—

1. Centrifugalization of Latex.
2. Coagulation by Acetic Acid.
3. Extraction of Caoutchouc by means of Mercuric Chloride (Corrosive sublimate).
4. Special methods applicable to particular latices.

The first three experiments were carried out chiefly with the latex of Hevea brasiliensis, but are probably equally applicable to other latices. Below we quote from Mr. Parkin's paper, the results of his experiments.

1. *Centrifugalization of Latex.*—Considering that the caoutchouc in latex exists in the form of minute globules suspended in a fluid, and that they are lighter than water, it is rather surprising that no one till now has thought of the idea of separating the caoutchouc and so preparing rubber by centrifugal force, such as is used for separating the butter fat of milk. The credit of applying the idea is due to Mr. Biffen, of Cambridge University, who, in connection with Mr. Esmé Howard, recently undertook an expedition through the rubber-producing districts of America. With a modified centrifugal milk-tester they tested the possibility of extracting the caoutchouc from several latices with great success. Some of their results are given in a paper by Mr. Biffen on "Coagulation of Latex" in the *Annals of Botany* for June 1898, as well as in the *Journal of the Society of Arts*, Vol. XLVII., December 23, 1898, p. iii.

The latex of *Castilloa elastica* is the one which yields most readily to centrifugalization. The machine used is described by

Mr. Biffen as "a modified form of the ordinary centrifugal milk-tester......capable of being rotated some 6,000 times per minute." Three or four minutes completes the separation in the case of *Castilloa.*

The advantages of this new process are obvious. The rubber can be obtained practically pure from the latex, without the admixture of proteid, &c., hence no liability to decay. Since the caoutchouc particles are obtained as a thick cream, which can be spread out on a porous surface, it allows of the rubber being prepared quite dry in a short space of time.

In connection with Mr. Biffen's discovery a company has been formed and a large tract of land laid down in Mexico in Castilloa, with the purpose of producing commercial rubber by centrifugalization. A patent has been taken out on the machine, and consequently it remains to be seen at what price it will be put on the market. It may be somewhat prohibitive. In the meantime, let us consider what other means there are for preparing good rubber from the latex of Hevea and Castilloa.

4. *Coagulation by Acetic Acid*.—The coagulating power of various acids has been tried on the latex of *Hevea brasiliensis*, viz., hydrochloric, sulphuric, nitric, oxalic, tartaric, and citric acids, and we have come to the conclusion that on the whole acetic is the best acid to employ.

All the acids bring about the coagulation in the cold, but much quicker when warmed. The amount required is extremely small, and varies somewhat for the different acids. If excess be added, then coagulation ceases to be complete.

The quantity depends on the quantity of pure latex and is independent of its dilution; or in other words, doubling the dilution halves the acid for a given volume. A certain weight of acid is required for 100 c. c. of latex, no matter whether this be diluted with water to 500 c. c. or 1,000 c. c.

The figures to be given are approximate only. 100 c. c. of pure latex are completely coagulated, *i. e.*, the liquid part is left quite clear, by—

0·1 gram	...	...	Sulphuric acid
0·1 ,,	...	...	Hydrochloric acid
0·3 ,,	...	...	Nitric acid
0·95 ,,	...	...	Acetic acid
0·2 ,,		...	Oxalic acid
0·25 ,,	...	...	Tartaric acid
0·5 ,,	...	...	Citric acid

From the above it is seen that much more acetic acid is required than sulphuric acid, for example; hence, why not employ the latter as being cheaper? The reason is that with all the acids except acetic, the range for complete or nearly complete coagulation is extremely small. As regards sulphuric acid, coagulation was not complete with 0·05 per cent,

of acid, about complete between 0·1 and 0·2 per cent., not complete with 0·3 per cent or 0·25 per cent., far from complete with 0·6 per cent. Thus, unless the percentage for the pure latex can in practice be brought between 0·1 and 0·2, all the rubber particles are not extracted from the diluted latex.

With acetic acid, however, the range is much greater. Coagulation is complete between 0·09 and 0·39 per cent and almost complete between 0·025 per cent. and 0·8 per cent.—a very considerable range, which can fairly readily be reached in practice. Thus, with acetic, the acid may be added either in quantities four times below the proper amount or nine times above it, with very little waste of rubber; whereas with the other acids such would mean a very incomplete coagulation. It is for this reason that acetic acid is advised in place of the others.

In Mr. Parkin's experiments the latex was usually diluted ten times; but, no matter what the dilution may be, the caoutchouc particles are capable of being collected together into a clot by the necessary amount of acid. This was even done for latex diluted 2,000 times. One c. c. of latex diluted to 2,000 c. c. requires, of course, just the same quantity of acid as if it was diluted only to 5 c. c. The common B. P acetic acid was used, in the proportion of 3 c. c. of acid to 100 c. c. of pure latex.

The following is the application of this method of preparing rubber from the latex by means of acid. If possible the volume of pure latex should be known, and then the required amount of acid can easily be calculated. Otherwise the times of dilution of the latex should be known approximately, and then the acid calculated for the whole bulk of fluid.

In the Ceylon experiments a known quantity of water was added to each collecting tin, about 5 c. c. Since the latex of Hevea is so thick, a little fluid previously put into the tins is necessary to prevent the latex from drying. The whole of the collecting tins are emptied into a measuring cylinder and the amount of latex ascertained by deducting the quantity of water added. The washings of the tins, &c., are all added to the diluted latex, and the whole passed through a sieve made of coarse cloth, which removes particles of bark and other impurities. A second filtering is desirable. The latex now diluted, perhaps 20 times, is heated to nearly boiling point over a fire; any scum that may rise is removed, as it contains any remaining dirt which has passed through the cloth. If ammonia has been added to the water put in the tins to prevent spontaneous coagulation, the heating is continued for ten minutes or so to drive it off, else it will interfere with the coagulation. The milk should be continually stirred. The requisite amount of acetic acid is now added and the whole briskly stirred, when

in a few seconds the caoutchouc separates out in clots. The boiling vessel is then removed from the fire and copious cold water added. The rubber clots are opaque and white in appearance; the liquid part should be quite clear or show only a slight turbidity. If quite clear, it shows that the whole of the rubber particles have been collected together into the clots; otherwise there is a little caoutchouc still in suspension: the greater the turbidity, the more caoutchouc globules remain in the liquid. The coagulum of rubber is quite soft and spongy and ought to be pressed out into thin sheets—the thinner the better—in order to allow the rubber to dry quickly. If pressed into pieces of the thickness of ⅛ in. (3 mm) or even less, the rubber soon dries provided the atmosphere is not very damp. The whitish opaque appearance gradually disappears and the rubber becomes translucent and of about the colour of gelatine.

Such rubber, if it does not dry quickly—and it is sometimes difficult to get it to do so on account of rubber districts being damp places—is apt to putrify or at least mould. To prevent this it is advisable to add along with the acid a little creosote in alcoholic solution, about 0·5 per cent. of the total bulk of fluid. This will hinder growths of mould, &c., during the time the rubber is drying. Creosote has been found more effectual than phenol (carbolic acid), as it does not evaporate so quickly.

Mr. Parkin has not tried any artificial means of hastening the drying of rubber. It should on no account be placed in the sun. The intensity of a tropical sun quickly gives to the surface a stickiness which is permanent and cannot be readily removed, and which renders the rubber less valuable in the market.

To dry rubber by heat does not seem advisable. If any artificial means are to be used, they should be more in the direction of hygroscopic reagents, such as quick lime or calcium chloride placed in the drying chamber. But if the rubber be rolled into very thin sheets it soon dries of itself in good weather.

It was stated before that the acids coagulated the diluted latex in the cold. With acetic this takes place after a few hours. The whole of the caoutchouc globules are gradually gathered together into a very loose clot, which can readily be removed from the clear liquid and pressed into a sheet of rubber.

This method may ultimately prove better for use on the large scale than the "hot" method, but it is difficult to use creosote in the cold as it will not then mix with the milk.

3. *Extraction of Caoutchouc by means of Mercuric Chloride (Corrosive sublimate).*—The coagulating power on the latex of Hevea of several salts has been tested, viz., sodium chloride (common salt), alum, ammonium sulphate, magnesium sulphate, and mercuric chloride. Stating the results as for the acids, 100 c. c. of latex is completely or nearly coagulated in the cold or boiling by—

7·5 to 12·5 per cent. sodium chloride (coagulation very partial, fluid left milky in all cases). 30 per cent. alum (40 per cent. and 25 per cent., not complete). 40 to 50 per cent. ammonium sulphate. 2·5 to 10 per cent. magnesium sulphate. 8·3 per cent. mercuric chloride.

Mercuric chloride (corrosive sublimate) is the only one which has a strong and complete coagulating power on the latex. From 0·3 per cent. upwards all the caoutchouc is separated from the diluted latex, leaving the liquid part quite clear. It can thus be used for preparation of rubber from the milk.

It acts better in the cold than when heated. Boiling the milk with it is apt to make the coagulation incomplete, the liquid part being left turbid.

The calculated amount of an aqueous solution* of mercuric chloride is added to the latex, diluted some ten times and then vigorously stirred. In a few minutes a separation of the caoutchouc in small flocculent portions is observed; these gradually rise to the top, being lighter than the water, and after the lapse of an hour the caoutchouc is in the form of a lumpy cream on the surface. If allowed to remain longer, say twelve hours, the cream becomes a clot, and can be lifted out and pressed on to a sheet of rubber. It is perhaps better to remove the rubber in the cream form by running off the liquid below, either by a syphon or, better, by means of a tap at the bottom of the vessel; the cream can then be poured out in a thin layer into a porous surface and so speedily dried.

The advantage of this method over the acetic acid one is two-fold. Firstly, the rubber is perfectly aseptic and cannot putrify or mould. Secondly, the creaming allows the rubber to be dried quickly. The objections are the very poisonous character of the reagent and the presence of mercury in the rubber, although this is extremely small, about 0·75 per cent. of the salt in the dried rubber.

4. *Special method relating to Castilloa.*—The latex of Castilloa is found to cream with the greatest ease. The comparatively large caoutchouc globules in the diluted latex float to the top to form a thick layer on the surface of the liquid below. This permits of a simple means of preparing good rubber from the latex.

"When the latex of Castilloa is mixed with water and allowed to stand, in the course of an hour or two the caoutchouc particles have all floated to the top to form a thick cream over the brown beer-like liquid below. This liquid can be syphoned off, or, better, removed from the vessel by a tap at the bottom. The cream can then be mixed up with water again and left to stand, and when the caoutchouc has again risen to the top the liquid can be run off a second time. After a third washing most of the

*The salt is not very soluble in water. A 4 per cent. aqueous solution was used.

solub e matter of the original latex will have been removed. The thick cream is now ready to be dried in thin layers either by mere exposure to the air or on a porous surface."

The cream may be poured out on a clean surface in thin layers and the water allowed to evaporate, when the individual globules of caoutchouc fuse together to form a sheet of rubber. Mere atmospheric evaporation is slow The drying is done much more speedily by pouring the cream on to a porous surface made of some fine earth. When dry, the rubber is so transparent as to be almost invisible. It is then striped off and is ready for market. Two objections or drawbacks to a porous surface are to be mentioned. In peeling off the sheet of rubber particles of the surface are liable to be detached and rolled up with the rubber; this can be largely prevented by having the porous surface smooth and unfriable. The absorbing power of a porous material diminishes with use, especially if the watery part of the rubber-cream contains much soluble matter, because then the pores are apt to be clogged. What may be the best porous material is still a matter of consideration.

Rubber prepared carefully by the above method should contain very little impurity and command a good price. It should in fact, be as good as that obtained by means of the centrifugal machine, although this latter allows of a much speedier preparation of rubber from the milk

The rubber thus obtained is so dry that it is practically unnecessary to use any antiseptic or preservative such as creosote; but of course it should be packed carefully and exported as soon as possible, as rubber soon spoils in a tropical climate.

In conclusion, attention should be drawn to a fact which is very clearly brought out in many of Mr. Parkin's experiments namely, that the amount and quality and even many of the properties of latex or rubber extractable from the trees introduced into Ceylon is much less than, and very different in many respects to that obtained from the same trees in their native homes, or even, so far as the *few available results* indicate, in other Eastern countries.

Again, there is a great individual difference in the trees in the yield per incision; and also considerable variation in yield of latex per incision according to the time of year, or perhaps rather to the state of the weather—moisture being apparently the great requirement for flow of latex, and therefore tapping should be done just after a spell of wet weather. Not only this, but the nature of the soil as regards its retentiveness of moisture; the time of day, early morning being apparently the most favourable time; exposure to sunshine (sunshine on the incisions is to be avoided, as the heat dries the latex on the wound)—these are all questions which affect to a very great extent the yield of rubber obtainable.

Many points, however, still remain for investigation, and the experiments initiated by Mr. Parkin are being continued at the Peradeniya and Henaratgoda gardens in Ceylon; and we are glad to note that their further results, and the reports of experts upon the samples of rubber now in hand are to form the subject of a subsequent Circular.

The Circular concludes with a list prepared by the Director, Mr. John C. Willis, of the more important books and papers relating to the subject of India rubber, which are to be found in the Library of the Royal Botanic Gardens at Peradeniya, Ceylon. This list is here reproduced as many of our readers may doubtless be glad to study the question further.

Literature.

General

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Special

Castilloa—*see* Circular 11.
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Kew *Bulletin*, 1888, 217; 1891, 97; 1896, 171.
Strettell, Ficus elastica in Burma, 1876.
African Rubbers:
Kew Bulletin, 1888, 253; 1889, 63; 1890, 89, 1895, 241; 1896, 76.
Notizblatt, Berlin.
Colombian Rubber:
Kew Bulletin, 1890, 149.
Para Rubber:
Circular 4 of this Series.
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A. C.

Forestry in Algeria.

The Revue des Eaux et Forêts for the 1st May last contains a summary of the history of Forest Administration in Algeria by M. Grimal, Inspecteur Adjoint des Eaux et Forêts, from which the following brief notes are extracted.

The Algerian Forest Service dates from the year 1836, or shortly after the conquest of the country. It was in this year that M. Bresson, Civil Administrator in Algiers notified to the Minister for War the necessity for creating a Forest Service. This proposal being accepted by the Government, resulted in the nomination of M. Armanton as Chief Forest Officer in Algeria.

In 1838 two Forest Officers and a mounted Guard were appointed, and M. Armanton who was not a member of the Forest Service gave place to M. Renou, a Forest Officer of some ten years' service who may be regarded as the founder of the Algerian Forest Service.

Young, active and intelligent, he was not long in obtaining from Government a considerable increase in the Forest Staff. The first subordinates were appointed in 1840 at which time the staff consisted of eight superior officers, one inspector, forty one subordinates and an interpreter. In 1844 M. Renou was killed by a fall from his horse and after a short interval was replaced by M. Galmich.

In 1846 native guards were first appointed, and a year later the staff was further increased to a total of 13 superior officers, 48 French guards and 21 native guards.

It was not long before such an establishment was found totally inadequate for the purpose of administering so large an area of forest in a country where forest restrictions were neither understood nor appreciated and where a large part of the population was still hostile. Gradually however as the value of the forests came to be realized, further measures were taken for safeguarding this source of wealth.

In 1849 a chief inspector was appointed for each province under the orders of the prefect in territories under the civil authorities and under those of the general commanding in territories under the military authorities. Such an arrangement naturally did not tend to simplify the work of the forest officials owing to the frequent impossibilities of reconciling political requirements with measures indispensable for the proper protection of the forests.

The application of the French Forest Act met with a lively resistance and in 1871 prior to reorganizing the service M. Tassy, Conservator of Forests, was deputed to examine into and report on the whole forest situation. M. Tassy's report contained proposals for several reforms which he considered indispensable and most of the measures he proposed are even now after an interval of 27 years, retained intact at the present day.

M. Tassy's report was followed by the reorganization decree of the 27th September 1873, placing the Department under the Governor General and appointing a Conservator at Algiers to administer the department and to exercise under the chief civil and financial authority all the powers common to Conservators in France.

The demarcation of the forests by a special establishment was ordered in 1875 in which year the permanent Forest Staff was largely increased to 69 superior officers, 288 French guards and 111 native guards.

In 1881 the Governor General's powers were modified and his right of interference in forest matters considerably reduced; and in the following year three Conservators, one for each province, were appointed instead of one.

In 1888 the subordinate staff was still further increased, the number of French guards being about doubled; and in 1892 a large increase of expenditure was sanctioned for improving the working and protection of the forests.

Consequent on the debates which took place in the senate in 1892 on certain difficulties which had arisen in the matter of forest conservation in Algeria, a commission was appointed under the presidency of M. Jules Ferry to enquiry into and report what reforms were necessary to bring the Forest Adminstration more into harmony with the people and the local requirements of the Colony. The Department received some severe criticism from the president of the commission who finally proposed a return to the old organization of 1873.

The report of the commission resulted in the suppression of the modification introduced in 1881, which decentralization has considerably increased the powers of the Governor General who may now issue orders in numerous cases in which previously he was only able to advise. In 1898 the then conservators' charges were divided into 71 divisions and 3 "chefferies," the staff consisting of 68 superior officers, 817 French guards, 196 native guards and 4 interpreters.

A. F. G.

III.—OFFICIAL PAPERS & INTELLIGENCE

Drought and Forests in the C. P.

It may interest the readers of the "*Forester*" to learn what effect the long continued drought in the southern portion of these provinces has had on forest growth, though it is rather too early to judge accurately of the damage done. Later on when the rains have had time to freshen up vegetation, we shall be in a better position to estimate the losses, which in certain soils and areas will undoubtedly prove somewhat serious, and it is hoped that a further communication on this subject will be forthcoming.

Nothing abnormal is reported from the eastern districts of Sambalpur and Bilaspur, as frequent showers of rain occurred this year throughout the spring. In the latter district most species were rather later than usual in bringing out a new flush of leaves.

Mr A. M. Long reports on the drought in the Raipur Division in these terms :—

A.—Direct.

1. *Damage to Timber trees.*

The absence of damage to timber trees throughout the forests of this division was most noticeable. I cannot definitely record a single instance in which a *timber* tree in Government forest has been killed owing to the drought. Some Sâl seedlings (4" or 5" high) I found dying. These were advance growth, along the edge of Sâl forest, the seedlings growing in comparatively thin grass jungle. Some small fruit trees, Achar (*Buchanaia latifolia*) I found dying, the upper parts in many cases being withered up.

2. *Damage to fruit.*

The *Mohwa* † crop was very much damaged by the drought. The flower buds shrivelled up with the heat and want of moisture.

The *Achar* crop promised well and was on the whole a fair one, but (as above noted) a number of Achar trees died, and this occurred before the fruit had ripened.

The *grass* —both thatching and fodder—was in parts of the district a very good one; it matured early but the drought dried it up quickly, and in many cases it was too woody to be of value when the usual time for cutting came.

The Hurra * (myrabolam) crop was a 'bumper'; the dry season ripening and maturing the fruit to a nicety. The new crop of flowers and fruits which appeared, owing to some rain in April, earlier than usual, has since suffered but little, as the occasional rain that has fallen since April has been sufficient to save it from withering up.

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†Bassia Latifolia, * Terminalia Chebula.

B.—INDIRECT.

"The early drying up of the grass and undergrowth left little good grazing for cattle and wild animals, and in consequence seedlings, saplings and coppice shoots suffered considerably from being cropped down. This was most noticeable in the dry and rocky Ranges of Dhamtari and Balod. In Balod Range all the damage to coppice growth in the compartments recently cut over had been done by wild animals (Shambhur, Spotted Deer, Nilgai and 4-horned Antelopes); in Dhamtari the illegal grazing of cattle in some of the closed compartments had, in addition to the cropping of the shoots by deer and antelope. caused considerable damage. Again, the drought was indirectly responsible for the unprecedentedly large number of fires that have occurred. The early drying up of the forests greatly lengthened the fire season, and secondly, the presence throughout the jungle of scattered coolies, chiefly women, collecting minor forest produce and fuel, which had been granted free, was a great danger impossible to guard against, and thirdly, the fact that often 90 per cent. of the men from villages near Government forests were away at famine relief camps, made it often impossible when fires did occur, for the forest subordinates to obtain, until after great delay, sufficient men to extinguish the fires.

"The mortality among mango trees in groves *outside Government forests* was very noticeable in the Dhamtari Range, many hundreds, if not thousands, of mango trees have been killed by the water-level in the sub-soil falling. The upper branches first wither and die, and then as a rule, but not always, the lower and side branches follow suit."

Mr. C. M. McCrie sends the following notes regarding the forests in the Nagpur district:—

"The yearly rainfall in this district averages about 46in., but from 1st June 1899 to 31st May 1900 only about 14in. were received. All but 2in. of this fell before the end of August 1899. The resulting drought has done comparatively little damage to forests growing on crystalline formations, but those on trap soils have in many places suffered severely. The damage is not confined to any special aspect or gradient, but is, as might be expected, more severe on hill slopes, where the soil is stony and shallow, than on the deeper soils at the bases of the hills.

"The Aonla (P. emblica) has been the greatest sufferer, especially young stems under 18in. in girth. These are frequently found to be cracked from top to bottom, a single large crack running the whole length of the bole, extending right into the centre of the wood, and gaping 1in. to 1½in. on the surface. In larger stems several smaller cracks are usually found at different points on the circumference. In many of the drier forests not a single specimen of this species can be found which has escaped injury. This is the more remarkable in that the Aonla has, in

this district, been absolutely bare of foliage since December 1899, so that transpiration has been reduced to a minimum. Its thin bark gives but little protection against the sun, and the broad medullary rays render the wood easily fissile, but several other species which appear almost equally vulnerable in these respects have suffered but little.

"Saj (T. tomentosa) has also suffered, though to a less extent, than the Aonla. The wood of the stem is not found to have cracked, but the bark, owing to the death of the cambium, has separated entirely from the wood, and has either fallen off or remains loosely attached to the tree, hanging in long strips. In the case of this species, however, only the weaker and less favourably situated individuals have succumbed. There has been nothing like the general mortality noticed in the case of the Aonla.

"Koha (T. Arjuna), which in this district is found only along the banks of water-courses, shows clearly the results of the exceptionally low level of the sub-soil water.

"Being naturally a shallow-rooted species, it trusts for its water-supply to its favourable position on the banks of streams. These failed almost entirely this season, or at least dried up at an exceptionally early date. Many of the Koha have therefore died, their bark separating from the wood and falling off in large rectangular plates.

"The mango, though not a forest tree, deserves mention. Being an evergreen, transpiration has been extremely active during the last few months of the hot weather. The results of this have been disastrous, as the roots have been unable to obtain a sufficient supply of water from the soil to make good the large daily losses through the leaves. The crown of many of the largest trees thus completely withered and died. The smaller individuals have of course suffered most; in fact in many villages hardly a single tree under 2ft. in girth is left alive. In the larger trees the gradual approach of death is clearly seen. The highest twigs and those at the extremities of the lateral branches are the first to wither, while those nearest the main stem are the last to succumb. The dead trees are now being utilized all over the District as timber and fuel, but the loss to the cultivators is very great, to say nothing of the effect on the scenery which can ill stand the loss of even the smallest touch of green during the hot weather.

"The kathang bamboo (B. arundinacea) has suffered here and there on dry soils, where several of the weaker culms of each clump are often found to have cracked and died. The ordinary bamboo (D. strictus) seems to have entirely escaped injury.

"Other species of trees have apparently suffered comparatively little, only isolated individuals having succumbed here and there in exceptionally unfavourables localities. Teak, thanks to its deep tap-root, has so far escaped altogether.

"Coppice shoots of three years of age and over have not been affected. Younger shoots have suffered severely, teak being in this case the first to succumb. No doubt its large pith renders it exceptionally vulnerable. One year old shoots have in most cases died right down to the stool. Two year old shoots have sometimes shared the same fate, but in most cases they only show signs of distress at the top, the lower half or two thirds of the stem being still green.

"It is hardly necessary to say that there has been absolutely no regeneration from seed during the year, as this is, even under the most favourable circumstances always scanty in the forests of this district. Such seedlings as had managed to get a footing during the previous three or four years were killed off by the drought early in the present season."

Baboo Gunga Pershad Khatri writes as follows from the Seoni District:—

"All trees and especially teak shed their leaves this year early in November 1899 in the forests below the ghats in the Korai Range.

"The new leaves on the trees noted below appeared in the same forests, at least three months before the ordinary time, that is, early in December 1899.

Anogeissus latifolia (Dhaura)
Ougeinia dalbergioides (Tinsa)
Lagerstrœmia parviflora (Lendia)

These new leaves, however, faded away.

"Several trees but especially teak of girths under 2 ft. dried off in the month of May 1900 in the Samnapur Forests (Narbada Range), Barubund and Sahajpuri Forests (Cehapara Range), and parts of Korai and Gangeyanala Ranges below the ghats."

Baboo Chander Kumar Chatterji, Rai Bahadur, writes as follows from Bhandara:—

"In the dry forests of the Bawanthari and the Paoni Ranges, the terminal shoots of most of the saplings of Saj, Dhaura, Lendia, Garari† and Achar* have more or less dried up. A few of these may recover during the ensuing rains.

"The coppice shoots from stools in the areas cut over last year were not at all vigorous, they were sickly and their average height was less than 4 feet, whereas in ordinary years the average height attained by coppice shoots was 6 feet and over.

"The trees began to shed their leaves two months before the usual time and in January the forests assumed the dry appearance of the months of April and May.

The grass on the boundary lines became dry and inflammable as early as December, the fire-lines were cleared and burnt before the 15th January; whereas in ordinary years the

*Lebedieropsis orbicularis.
†Buchanania latifolia.

burning of fire-lines are taken in hand after the 15th January and completed by the end of February.

"The season was very bad for natural regeneration; very few seed germinated for want of moisture in the soil. Moreover, Saj, *Dhaura*, *Lendia* and *Garari did not seed well.*

"All the springs inside the forests dried up, and old men of eighty years of age have told me that they never knew such scarcity of water in their life. It may be noted here that a spring called the "Ummer Jhira" in the Gaikhuri Range also dried up, to the great surprize of the surrounding villagers, for it was called "ummer" which means never failing, as it was never known to have dried up before this."

From the Chindwara District, we have the following notes by Mr. J. J. Hobday :—

"In the month of July 1899, the Range Officer of *Unett* reported a fire in the Kamhan block on 2-7-99. The rainfall of June and July was not sufficient to cause the old grass of the previous year to fall down and rot and the fire which occurred burnt this old stuff while the new season's grass remained more or less green underneath.

"In the middle of October last the teak forests on the hill slopes in the Sillewani Range were inspected and found to be quite or almost leafless. The forest looked there very much as it usually *does in February.*

"Very little green of any kind has been found in any of the forests of this District this year.

"Large numbers of trees in the dry hilly parts of the forests, all over the District are dead or dying, only trees in deep valleys look healthy and green.

"In the end of October and the early part of November I saw one mohwa† tree in flower in the Sillewani Range near Ramakona, and one Palas* tree was in flower near Paraspani in the Sank Range.

"The *general effect of the drought on* the mohwa tree was to prevent it from bearing flowers this year. As far as I can estimate the mohwa crop this year was only about one-tenth of its normal amount. I also saw several mohwa trees put forth a great crop of flower buds, all of which withered before the flowers were fully developed. Many mohwa trees appear to be quite dead now.

"One very marked effect of the drought is to cause a long delay in the development of foliage. Mohwa is usually in leaf in April and May but even now in the middle of June very few mohwa trees on the drier soils have any *leaves at all.* Only trees in deep valleys have a good flush of new leaves.

"The drought has had a very marked effect upon the animals and birds in the jungles. There is so little water anywhere in the jungles that the monkeys that are so numerous in

†Bassia latifolia *Butea frondosa.

these forests are obliged to come to the village wells for water. Where they find any water in troughs used for watering cattle they drink it, but where there are no cattle troughs they have been found jumping down into deep wells where they have been imprisoned for several days being unable to get out again. It is reported that 13 monkeys jumped down a certain well on the same day.

"The Sank Range Officer reports that the birds are so badly off for water that they come into village huts and drink out of the people's water pots. Several have been caught in this way. The Sillewani Range Officer reports that he came upon a herd of wild pigs in the Aniakni forest and got up to within 60 yards of them. The pigs were quite thin and miserable and unable to run, though he took up his stick and tried to make them run."

[*Communicated by Mr. A. Smythies, Conservator of Forests, S. C. C. P.*]

Ceylon Timbers.

The Scientific and Technical Department of the Imperial Institute have recently published (Imperial Institute Journal, Vol. vi. No. 65.), a report on the results of technical tests applied to a series of logs of timber supplied by the Ceylon Government to the Imperial Institute. In presenting his report upon the specimens of Singalese timber tested by him,

Mr. Herbert Stone, F. L. S., one of the expert referees of the Institute offers a few preliminary remarks upon the conditions necessary for putting new varieties of timber upon the English market—remarks which all Forest officers, and especially the critics of the Indian Forest Department, would do well to ponder over. He writes:—

"It must be borne in mind that the bulk of our timber trade is limited to but few kinds, which every manufacturer keeps in stock. Beyond these favourite woods there are many varieties having a more restricted sale, which are used for special purposes. It is obviously more to the interest of every trader to limit his purchases to a few kinds of wood which he can stock largely, and thus buy to better advantage, than to use a number which must be purchased in smaller lots. This makes the introduction of novelties in timber a task which becomes harder as the variety increases, and fresh arrivals will stand little chance of obtaining a footing unless they exhibit striking differences in colour, or peculiar merits in other directions. Such woods may, with the help of assiduous advertisement, slowly take their place in the list of commercial timbers, but all those which are inferior to, or merely as good as, those with which we are already familiar stand little or no chance of sale. From this category must be excepted those resembling in some way our staple timbers, and which will pass under the same names. There are three examples to the point amongst these Singalese woods; *sureva mara* would sell as rosewood of inferior quality; *halmilla* as satinwood, and *sunmidella* as a cedar or mahogany, and if imported as "Ceylon rosewood," "Ceylon satinwood," and "Ceylon cedar," would readily be bought on trial, and probably adopted for many purposes. There would be no deception in this procedure, as the numerous cedars, mahoganies, and ebonies which are now continually sold are a congeries of miscellaneous species belonging to various genera, and in many cases to entirely different natural orders, whose sole claim to their trade names is their resemblance to better-known woods in colour and grain. Unless this plan be adopted, there is only one out of the nineteen species of Ceylon woods which can hope to gain a footing here.

"Another point of scarcely less importance is the condition in which the logs are sent to the British market. With few exceptions those received were in unmarketable condition, being cracked (shaken) and split past all hope of making anything of them, and it was with the greatest difficulty that a plank sufficently wide and presentable for exhibition purposes could be obtained from them. A few of the logs were tainted with the mycelium of a fungus in addition to being otherwise in bad condition, but this may be ignored, as the fungus was one frequently met with at home, and which may have attacked the logs since their arrival in this country."

Twenty-one specimens were tested by Mr. Stone, namely:—

No. 1 Michelia Champaca	No. 12 Melia Azadirachta*
" 2 Pleurostylia Wightii*	" 13 Melia dubia*
" 3 Calophyllum Burmanni	" 14 Calophyllum bracteatum
" 4 "*Vainaka*"	" 15 Persea semicarpifolia
" 5 Vitex altissima*	" 16 Heritiera littoralis
" 7 Zizyphus Jujuba*	" 17 Thespesia populnea
" 8 Vatica affinis	" 20 Berrya Ammonilla*
" 9 Carallia Calycina	" 21 Albizzia odoratissima*
" 10 Dichopsis petiolaris	" 22 Pericopsis Mooniana

11 Carallia integerrima*

The above are the catalogue numbers given to the specimens by the Imperial Institute authorities, and we have marked with an asterisk those species, which are either widely distributed or abundant in India, more especially in Southern India, Bengal, Burma, the Andamans, or in the south of the Western Peninsula of India.

Below will be found Mr. Stone's description of the three species, which he thinks might be readily accepted in the London market, on account of their similarity to other staple timbers. "The tests to which the timbers were submitted were carried out with tools such as are found in most wood-working establishments, namely, cross-cut and circular saws, hand-planing machine, hand-turning lathe and hand-slide turning machine (running at 6,000 revolutions per minute). The turned specimens were polished upon the lathe, and the planks by hand, by the ordinary French-polishing method. The polish used was colourless and transparent."

No. 13. Lunumidella (*Melia dubia, Cav.*). A large handsome tree of the mahogany tribe (*Meliaceæ*), which is found distributed over India from the Himalayas to Burma and Ceylon. For reasons stated at the commencement of this report it would be advisable to call this wood "Ceylon mahogany," which would be abundantly justified by the fact of its position in the genus *Melia*. The specimen log, which measured 51 inches in girth, excited the interest of my workpeople immediately they commenced to unload it from the wagon. Assuming from the size of the log that it would take three men to handle it, they were amazed to find that one only was required. Its lightness is very remarkable, and from this quality alone it should have

a future before it. The ease with which it can be handled suggests great economy in transport. It has the additional virtue of being a wood of considerable beauty. It is of a delicate salmon-pink colour with a satiny lustre, even when merely split, and is very prettily marked. The log, unfortunately, had one crack which reached right across and a second which penetrated to the heart, thus ruining a very fine log of wood. There is a narrow spongy pith in the centre which would always spoil the middle plank, but with skill a waste of more than ⅜ of an inch could be avoided. Lunumidella saws and planes with exceptional speed and ease, leaving a perfectly smooth and lustrous surface after the latter operation. Machines for dealing with this wood could be driven as fast, or even faster than with deal. It resembles a light coloured cedar rather than a mahogany. It has sufficient sapwood (1½ to 2 inches wide) to protect the log during seasoning and transit, but not enough to make it necessary to have the logs hewn before shipment. As might be expected this wood turns with great ease, but a smooth surface cannot be obtained with tools merely. With glass paper it is readily and quickly scoured. It is, unfortunately, too soft for machine turning and rips to pieces in splinters, besides which the centre-bit sinks deeply into the work though, strangely enough, it does not readily burn by the friction. By special study the difficulties might be overcome, in which case the phenomenal lightness of the wood might make it of great value.

To obtain the best effect of the grain, lunumidella must be cut in the direction of the radius, *i. e.*, quartered, as the beautiful satin lustre does not appear in the tangential section. When polished, which requires much trouble on account of the highly absorbent nature of the wood, the beautiful salmon-pink colour unfortunately disappears, giving place to a bright yellow ; it then resembles polished American birch of good quality. Its weight is 20·3 lb. per cubic foot (Unwin), equalling 112 cubic feet per ton. (Compare cork : about 15 lb. per cubic foot). Watt gives the weight as being from 23·26 lb., and I am inclined to think that this weight will be more frequently met with than the lesser one of Professor Unwin. The wood is used, in Ceylon, for ceilings, and for outriggers in boats, according to Watt, who suggests its use for tea-chests. He does not consider it either so strong or so durable as its near relative, the Margose or Nym tree (No. 12).

Thwaites and Hooker say that the "loonoomidella"-gass is *Melia composita*, Willd., which is regarded as a synonym by Watt, also that loonoomadala-gass is another tree belonging to a different genus and named *Stereosporium chelonoides*, *D. C.* The wood of this latter tree is described by Watt as being reddish-brown or orange-coloured, close and even grained, astic and durable but soft, takes a good polish and weighs 45

to 48 lb. per cubic foot," and is used for tea-boxes, house-building, etc. It is evident from this that two most distinct trees pass under similar vernacular names and there is much room for confusion between the two if these names be employed in trade.

No. 20. Hamilla or Trincomali-wood (*Berrya Ammonilla, Roxb.*) A large tree belonging to the lime-tree family (*Tiliaceæ*). It is found in Southern India, Burmah and Ceylon. The specimen log was 33 inches in girth, was split to the centre, and was badly shaken elsewhere. The wood is extremely troublesome to saw, both longitudinally and transversely. The heartwood is proportionately large, being 9 inches out of 11 inches diameter, and is of a beautifully lustrous light-red colour somewhat resembling satinwood. It planes readily and smoothly, except where the grain is curly, it is then rather difficult to smooth. It is a superior wood and improves upon acquaintance. When held in a certain light the surface of the planed wood is seen to be sprinkled all over with minute shining crystals. These add to the lustre of the wood, but would play havoc with the tools. The knots, which appear here and there, have an objectionable habit of ripping out during planing. It turns well like hard mahogany (the shavings coming from the chisel like silk), the surface obtained is extremely smooth and does not require glass paper. It acts equally well in the machine, which produces a clean smooth surface. The sample does not correspond to the description given by Watt, who speaks of halmilla as being "dark-red in the heart, very hard, close grained and apt to split." He mentions a specimen which was perfectly sound after being 50 years in Calcutta. His figure for the weight per cubic foot is 48 to 65 lb., and professor Unwin's 49·93, or about 48 cubic feet to the ton. In Ceylon, halmilla is used for carts, agricultural implements, spear handles and building generally In Madras the celebrated Masula surf-boats are made of it, which fact is a strong recommendation in itself.

No. 21. Suriya Mara (*Albizzia odoratissima, Benth.*). This is the sweet-scented mimosa, a tree of moderate size belonging to the *Leguminosæ*, found in the sub-Himalaya southwards and eastwards. It has 46 local names in India. The small log received was without bark and much shaken, but the streaks proved to be more or less confined to the sapwood, the heartwood being sound enough for commercial purposes. The wood is excessively hard, even harder than ebony, and cuts up with the saw with exceptional difficulty. There is a good proportion of heartwood, 11 inches out of 13 inches diameter, the sapwood being only 1 inch wide and therefore negligible. This timber is a genuine rosewood, and resembles that shipped from Honduras in every respect saving depth of colour, in which it is deficient. It has the grain, weight, density and aroma of rosewood, and was pronounced to be such by my workmen without hesitation. It

would find a sale as "Ceylon rosewood" at a low price corresponding to its lack of colour, but if this name would lead to confusion between this species and *Dalbergia latifolia* and *Dalbergia sissoides* (Indian rosewoods), the name of the port from which it may be shipped could be used in the place of the word "Ceylon." The logs of suriya mara should be allowed to season for at least two years before shipment, as the log under examination was quite wet, although it must have been felled not less than 18 months ago. As regards the turning, polishing, planing, etc., it compares with Honduras rosewood in all respects, except that the polish tends to make the colour rather browner, which is undesirable, but can readily be corrected.

This wood is used in India for all purposes requiring strength and durability. It is the chief wood used for cart wheels in Gujarat. Weight 57·61 lb. per cubic foot (Unwin), equalling 42 cubic feet per ton.

A disappointing Shot.

Panther Versus Pig.

It was a very hot evening towards the end of April 1891 that I started to walk the 12 miles to my next camp at Haldukhatta, where my tents had gone on in the morning, I having remained back to have breakfast in the forest bungalow at Saldhang.

For the first two or three miles my way led through more or less dense jungle, then on through open grass flats dotted about with plum (zizyphus) bushes and occasional giant semel (Bombax) trees.

The grass on these flats had been fired early in the year, with the result that numerous large patches, which were then probably too green to burn, had escaped.

It was from the direction of one of these grass islands, in which stood a magnificent semal tree about 500 yards off the road, that the most plaintive screeches reached me.

I at first thought it was probably a nest of young vultures, up in the semal tree, but as the cry continued I took my rifle and proceeded to investigate. The cry grew louder and louder as I neared the patch of grass and I could now distinctly hear heavy breathing and the occasional wuf, wuf, of a panther; but what he was up to I could not see.

A desperate struggle was undoubtedly going on in the dense grass within 40 yards of where I stood, but although I tried hard I could see absolutely nothing, so I proceeded to cautiously creep into the grass and gradually worked my way up to within 15 yards of the struggle. I could still see nothing, but could now distinguish the squeal of a pig in trouble, then his angry grunt, followed immediately by the wuf, wuf, of a panther who was apparently getting some nasty bumps.

The struggling animals gradually shifted round and I could eventually just see through the grass, alternately, a spotted skin, then a black one, and occasionally the tail of the panther waved in the air. I waited patiently, and when I thought I could see most of the spotted skin, I fired. Imagine my surprise and disgust when the next second a panther bounded over the grass and stood facing me within 30 feet, his mouth, neck and chest covered with blood and having a dazed appearance about him.

I immediately slipped in another cartridge and as he stood facing me I took a deliberate pot at his chest. I was, however, doomed to disappointment: to my horror the cartridge snapped, the loud click appeared to wake the panther from his reverie. For, that instant, he turned and disappeared like a flash over the grass.

I hurriedly reloaded and ran after him, but he moved so quickly and kept so well in cover, that I was only able to obtain a very difficult snap shot at him, which I missed.

I now returned to see what had happened with my first shot as I had not up to that time seen the pig distinctly. I found a two-thirds grown boar lying stone dead, shot through the head. So that although I had fired at a spotted skin, they were tumbling about so much that the moment I fired poor piggy's head must have come in line.

The poor beast had made a grand fight for his life; he was terribly torn and bitten; but judging from the tufts of the panther's hair that lay about he had given "spots" a very busy time. His tusks were only just appearing, he was therefore at a great disadvantage, but he had used his teeth well, and pigs can bite as I know from experience in running them down with dogs.

I also noticed that the pig's fore feet were terribly torn; the cleft of each foot was split up fully 2 inches and this I put down to his having used them to force the panther off whenever the latter got him by the throat.

The rifle I used on this occasion was a single 450 Express, "Field's patent falling block action." A single barrel rifle is at best but a poor weapon for anything beyond buck shooting, but when it fails utterly, like mine did on this occasion, I think to say the best it is hard luck.

L. K. MARTIN,
Divisional Forest Officer, Akola.

An Assamese fish trap.

It is not often that man can derive direct benefit from the predatory habits of wild animals, absolutely wild that is to say, for such animals as hunting leopards, otters and falcons have to be brought into a semi-domestic state before man can make use of them. I have sometimes seen a low caste or casteless native in India take to himself the kill of leopard or tiger, and occasionally I have come across instances of deer, hunted to exhaustion by wild dogs, being caught by jungle tribes, and the rightful hunters being deprived of their prey for which they have worked so hard; but in the case of which I have to tell, a village with about 50 inhabitants obtained its fish-supply for five or six months every year through the kindness of flocks of absolutely wild river cormorants.

The village, which was situated in the Kamrup District of Assam, lay on the east bank of a stream called the Kalsi—a stream that in the dry weather measured some forty or forty-five yards across. The inhabitants of the village were for the most part workers in a Government teak and rubber plantation which surrounded them on all sides, and were never over-burdened with money, and consequently kept their eyes open for any means to augment their usual daily fare of rice and vegetables.

Who it was that discovered to what a good use the frequent up-stream flights of river cormorants could be put, I never discovered, nor indeed could I find out for how long these flights had been taken advantage of; but I think it must have been a local man to whom the idea first came, for I never saw it adopted by any other river-side villagers in Assam. Needless to say the method was of the simplest nature, an Assamese inventor does not soar to great heights.

During late winter, spring and autumn, and more rarely at other times in the year, huge flocks of river cormorants from the Brahmaputra river sweep up the Kalsi, advancing flock after flock in single V-shaped lines, skimming now near the river surface and driving the shoals of fry to where the water is shallowest and there they are quickly gobbled up, and now, where the water deepens rising to a height of 40 or 50 feet and sailing on to the next suitable fishing ground. Just opposite the village the river is deep—10 or 15 feet that is to say, but below and above this deep pool are shallows full of fish. Into the deep water the villagers sink great open-work baskets of split bamboo, loosely filled with twigs and branches, and these they attach to the bank by means of cane ropes. Somebody, usually a child, remains on the watch, and as soon as the cormorants come sweeping up the river, the watcher screams out "the water crows, the water crows" (to translate literally the Assamese name for these birds). Instantly

every villager rushes out from his hut and the basket-traps are hauled to the bank as quickly and as steadily as possible. The first time I saw the baskets emptied I was astonished at the quantity and size of the fish they contained. There were about ten baskets, and each held from 50 to 80 fish, not little 2 or 3 inch minnows, but fish up to four pounds, at least half the fish being from a half to one pound in weight.

The majority of the fish were carp but there were only a small number of true mahser (Barbus tor) although the river was fairly well stocked with them especially in the upper reaches.

I have never satisfied myself why the proportion of small fish was so small as the mesh of the open-worked baskets was not large enough to account for this; it could not be that the fry were confined to the shallows, because after the cormorants had swept up stream they had frightened almost every fish from the shallow to the deep water; perhaps while drawing in the baskets to the bank most of them escaped, but why they should be more fortunate than the bigger fish I do not know.

Sometimes two hauls were made in a day, but this was not common, and to get three hauls in a week was considered satisfactory. Most of the fish were eaten fresh by the villagers themselves or by their neighbours, who were very willing to take them in exchange for rice, vegetables, fruit or tobacco, and such as remained over were salted and sun-dried, and became that evil-smelling article of food which in Assam is called 'hukhan mas.'

LONG TOM.

On Crows.

A friend of mine told me that crows could by instinct find out if the atmosphere over a particular region was unhealthy, and if so, that they would migrate to a healthier atmosphere.

My house is surrounded by a number of trees, where these birds are housed in hundreds. It so happened early in April last that they commenced thinning out, till they had disappeared to the last crow.

Quite simultaneously with their migration, cholera broke out, and now that cholera is fast disappearing, the crows are again mustering in their former strength.

Jolapur. L. DAS.

VI.—EXTRACTS NOTES AND QUERIES

Bamboo Manna.

The recent occurrence of a sweet secretion on the stems of bamboos growing in the central Provinces is a most interesting fact to students of antiquarian medicine.—Bamboo manna derives its name from the Sanskrit words—*Tvak-kshira*, "bark milk," *vansa-sarkara*, "bamboo sugar," and *vansa-karpura* "bamboo camphor." *Vansa-lochana* is the name by which it is known by Indian physicians of the present day. These terms would signify a manna-like substance exuding from the stem of the tree, but what is known and used as *vansa-lochana* all over India is quite a different article.

That bamboo manna is not a sugar, but a white, gritty body, now called Tabáshir, by Europeans, is gathered from the account of Dioscorides, and from the fact that no kind of sugar prepared from the sugar cane answering to this description was known in India in his time. Dioscorides writes: "what is called *saccharon* is a kind of concrete honey, found in reeds in India and Arabia Felix, in consistence like salt, and brittle between the teeth like salt." Tabashir, or bamboo manna, was known to the early Arab travellers in the East, and the port of Thana, on the western coast of India, was famous for this product in the twelfth century. Tabáshir is employed as a medicine for its cooling, tonic, aphrodisiac and pectoral properties. In its crude state, when taken from the inside of the bamboo stems, it is mixed with insect remains, and has a blackish appearance; but on gently calcining, it becomes quite white, with a pearly lustre. It consists of about 80 per cent of pure silica, with variable proportions of alkalis, water and organic matter. The history and properties of Tabáshir have been fully discussed by Sir David Brewster (*Philos. Trans.* 1819, *Edin. Journ Science*, vol viii, p. 286;) Sir George Birdwood (*Bombay Products*, p. p. 95-96); Dr. F. A Flückiger (*Zeit. des Allg. Osterr, Ver.* 1887, No. 14), and bySir D. Brandis, (*Indian Forester*, March 1887).

The only modern work which alludes to sugar in the bamboo is the "System of Botany," by La Maout and Decaisne. The authors remark:—"the young shoots of these two trees (*Bambusa arundinacea* and *B. verticellata*) contain a sugary pith which the Indians seek eagerly; when they have acquired more solidity, a liquid flows spontaneously from their nodes, and is converted by the action of the sun into drops of true sugar. The internodes of the stem often contain silicious concretions, of an opaline nature, named Tabáshir." Here is a distinction made between the manna forming on the outside of the stem and the Tabáshir found inside, but no reference is made to any record where the first-named exudation was observed or examined. Dr. Watt when writing the article on Bambusa for his "Dictionary of economic products

of India," sums up the general experience in regard to this point, and says:—"*nor has the spontaneous excretion of sugar on the outside of the stems ever been recorded by Indian travellers.*"

The strange appearance of the manna on the stems of the bamboo was reported last March by the Divisional Forest Officer, Chanda, Central Provinces, and notices of this phenomenon have been published in the local papers. The bamboo forests of Chanda consist of *Dendrocalamus strictus*, the male bamboo, a bushy plant from 20 to 30 feet in height, and affecting the cooler northerly and westerly slopes of Central and Southern India. This is said to be the first time in the history of these forests that a sweet and gummy substance has been known to exude from the trees. The gum has been exuding in some abundance, and it has been found very palatable to the natives in the neighbourhood, who have been consuming it as a food. The occurrence of the manna at this season is all the more remarkable, since the greatest famine India has known is this year visiting the country, and the districts where the scarcity is most keenly felt are in the Central Provinces.

An authentic specimen of this bamboo manna was sent to Dr. Watt, Reporter on Economic Products, Calcutta, and was subsequently handed to me for examination. It occurred in short stalactiform rods, about an inch long, white or light brown in colour, more or less cylindrical in shape, but flattened or grooved on one side where the tear had adhered to the stem. It was pleasantly sweet, without the peculiar mawkish taste of Sicilian manna (*Fraxinus rotundifolia*). It was soluble in less than its own weight of water, and the solution when allowed to repose deposited white, transparent crystals of sugar. The manna contained 2·66 per cent moisture, 0·96 per cent of ash, 0·75 per cent of a substance reducing Fehling solution and a small quantity of nitrogenous matter. The remainder consisted of a sugar which became inverted in twenty minutes when boiled with dilute hydrochloric acid (1 per cent), and from its solubility, melting-point and crystalline nature, appeared to be a saccharose, related to, if not identical with, cane sugar. It contained no mannite, the saccharine principle peculiar to true manna.

The bamboo and sugar canes belong to the same natural order of grasses, and perhaps it is not unnatural to expect them to yield a similar sweet substance which can be used as food; but it is a coincidence that the culms of the bamboo, hitherto regarded as dry and barren, should in a time of great scarcity afford sustenance for a famine-stricken people.

INDIAN MUSEUM, (Sd.) DAVID HOOPER.
Calcutta, May 3rd.

(*Nature, June 7th,* 1900.)

The Agricultural and Horticultural Society of India.*

The annual report of the above society for the year 1899 is published in the Proceedings and Journal for January—March 1900. Owing to the very unfavourable weather experienced during the rains, and failure of winter showers, the work of the year in the gardens was a good deal hampered, and for this reason there is little to record in the experimental section.

"Several new varieties of Cannas were imported, but none, except *Canna variegata* were found to be of any worth, all being inferior to the present collection. The above variety promises to be a decided acquisition to the foliage class of plants, its richly variegated leaves resembling those of a well coloured Draccena."

"In the fruit section there have been a few additions of desirable kinds of Mangoes. The young trees of Cherimoyer (*Anona Cherimolia*) planted out in 1897 are now about 20 feet high, but have not flowered, propagation was again attempted but without success. The sour-sop (*Anona muricata*) has also grown to a similar height, but did not, as was expected, flower. The stock of the species from the Upper Congo has been almost disposed of, the seedlings planted out doing well.

"Seedlings of the Fiji Papaya were planted out at the Nursery in July, but all perished except one, which turns out to be a male plant.

"The table Fig, Vine and Pear still prove unsatisfactory, the two former though easily propagated, invariably perish in the rains, while the Pears have not grown since they were planted out."

Experiments were carried out with three kinds of weed destroyers, (1) "*Acme Powder Weed Killer,*" (2) "*Eureka Weed Killer,*" (3) "*Scrub Eradicator*" "All three were used on the garden paths during the rains; the "Acme" soon killed all weeds and grass, but the other two, though destroying weeds and surface rooting grasses, only checked for a short period the growth of *Cyperus rotundus,* known as "*Motha,*" which has its bulbous roots deep in the soil, and *Imperata arundinacea,* the "Ulu-ghas," which also roots deep. To ensure success it is necessary to use weed destroyers in wet weather."

For the water-supply of the gardens at Alipur an aermotor was used with considerable success, pumping on an average in working hours, *i. e.,* from 6 a. m. to 11 a. m. and from 2 p. m. till 6 p. m., 5,000 gallons daily. Unfortunately, owing to the low altitude of the winter breezes, about 40-50 feet, and the height of the fans of the machine, 75 ft., it rarely works during the winter months, or from the middle of October to the middle of February.

*Proceedings and Journal of the Agricultural Society of India, for January—March 1900. Calcutta.

The Paris Exhibition.

Extract from the Forest Chronicle in the Revue des Eaux et Forêts, 1st June, 1900.

The exhibits of woods of different countries are scattered about at numerous points outside the Forest Pavilion, for instance, in the Rue des Nations, Sweden, Norway, Finland, Denmark, &c., have interesting constructions in wood and ligneous products in their respective pavilions. In the British Colonies' Section among the woods of India and Ceylon rises a portico covered with panels of fashioned wood, deeply carved and of various designs, which is quite a marvel of art. On the first floor is displayed a magnificent exhibit of the woods of the British Colonies and many beautiful photographs, among which are particularly noticeable those of the Forest School at Dehra Dun, a beautiful building, and also a group of the School Staff, not many in number, and of the students chiefly natives of India.

In the Siberian pavilions at the top of the Trocadero, the woods of this immense region occupy an important place alongside the fur-yielding animals.

The French colonies, particularly Indo-China, also display specimens and wood-work in their pavilions in the Trocadero.

The United States and Hungary, the latter especially, exhibit a large quantity of constructions and remarkable woods in the west wing of the forest pavilion. It is in this wing too, particularly on the ground floor, level with the quay that Russia, Hungary, Austria, Canada, Demark, Roumania and others have collected the most remarkable specimens of wood, both fashioned and in the log. Canada exhibits, together with the timber, a small living specimen of the tree in a pot which may facilitate recognition by those who are acquainted with the foliage of the different species. A section of the enormous log of Virginian Juniper, more than 5 ft. in diameter, surmounted by a half cylinder of about 3 feet diameter of the same wood shows the longitudinal and cross-cuts of this excellent timber known as Red Cedar, the fragrant wood used for making pencils. A small specimen, about 3 feet high, of this tree in a pot standing on the log shows at once that the tree is a Juniper and not a Cedar.

In the Algerian section of the Trocadero there is a very fine and instructive collection of the woods and other ligneous products of Algeria, and visitors are reminded that from the top of the monumental staircase leading up to this section, a splendid view of the *Champ de Mars* may be obtained.

The Forests in the Central Provinces.

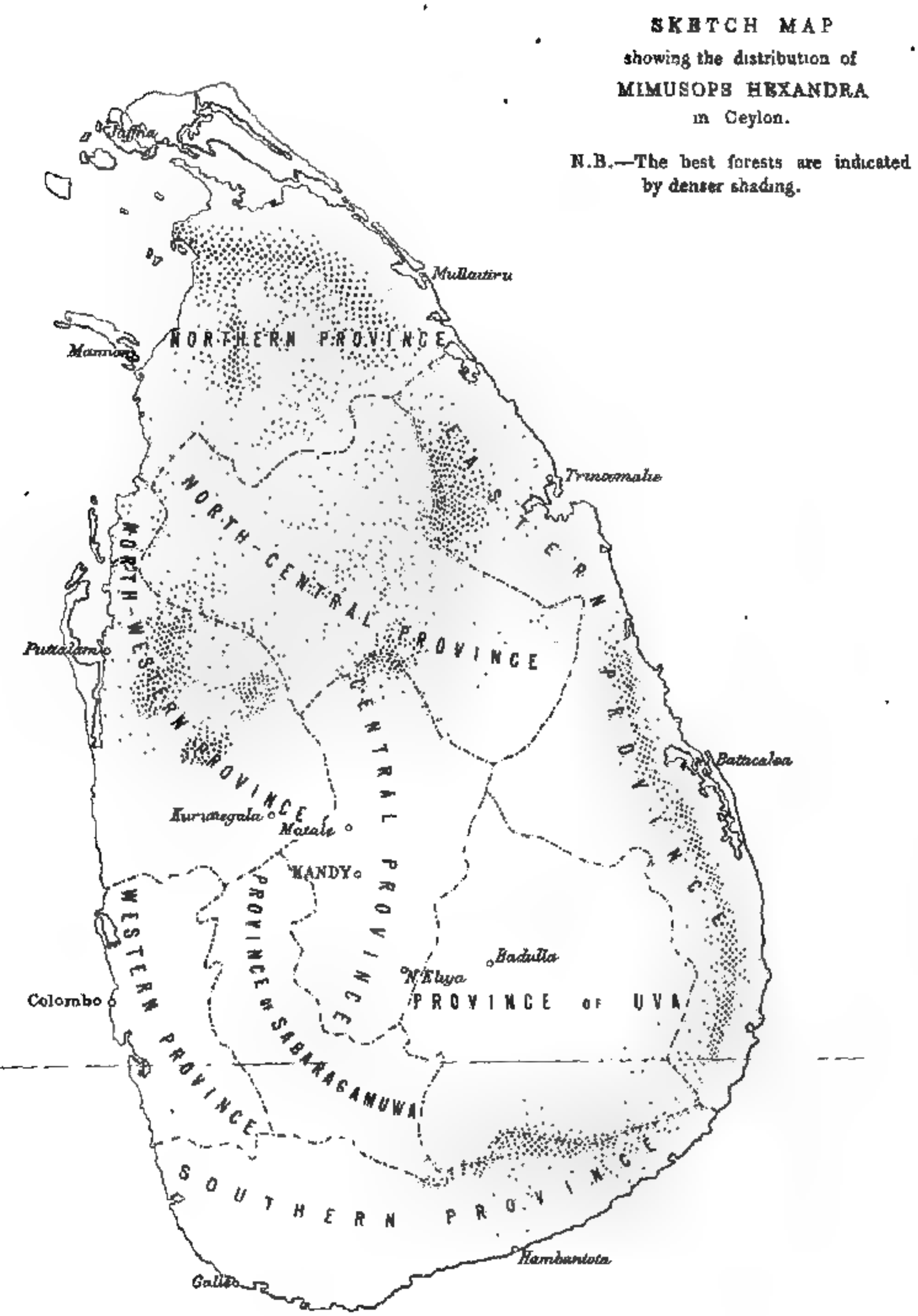
The Commissioner of the Jubbulpore Division, in forwarding the report on the Seoni forest, one of the most extensive in Central India, comments on the very small profit of Rs. 18,000 on an estate of 867 square miles, but says that this is due to the system of working, and not to the fault of the Divisional Office. He compares favourably the revenue realised from cultivation to that obtained from the forests. It should be recollected, however, that the forests are not worked on a commercial basis, and that the main object, at least in the greater part of that circle, is their preservation and improvement. The Department is not permitted to sell all its produce to the highest bidder, *e. g.*, an agriculturist can graze a bullock in the forests the whole year round for the absurdly small sum of two annas, and he is further entitled to get all his requirements in timber and fuel at moderate and fixed rates. The forests in this way are an enormous assistance to agriculture, and in many instances cultivation is only possible on account of this help. Thus, whilst forest revenue suffers, the agriculturist can afford to pay higher rent for his land, and the land revenue increases as the forest dues are lowered. Apart from this, however, it is only in exceptional cases that forests could come to yield as large a money return per acre as cultivated land, for the simple reason that they are mostly situated on stony shallow soils where agriculture would be impossible, whilst the cultivated lands occupy the richest soils in the Province.—(*Pioneer*).

Forestry in the Soudan.

We learn that Mr. C. E Muriel, Deputy Conservator of Forests, Burma, at present on furlough, has accepted an appointment to examine the forests of the Soudan, and to draw up a report on their economic value with suggestions for their treatment and working. Mr. Muriel will begin by visiting the forests on the White Nile in October next, as early as the season permits, proceeding subsequently to the Blue Nile.

There are extensive forests lining the banks of the Blue Nile which extend eastwards towards the Abyssinian frontier, as well as in the Bahr-el-Ghazel provinces. Along the White Nile, India-rubber-yielding creepers have been found. For years past heavy inroads have been made on the forests situated along the banks of both rivers, with the result that fears are already being entertained that the fuel supply is likely to be exhausted at an early date†. Great credit is due to the Soudan authorities for having taken steps to preserve the existing forests, before their utter and complete destruction had been brought about.

† Vide report on the Soudan by Sir William Garstin, K. C. M. G., published by Eyre and Spottiswood, London. Price 3d.



Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dun, July 1900.

THE

INDIAN FORESTER.

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Mimusops Hexandra, Roxb. in Ceylon.

This handsome and useful tree, known to the Sinhalese as *Palu*, and the Tamils as *Palai*, is one of the most characteristic and important trees of the dry zone. It is found at a low elevation in situations having a rainfall not much over 50 inches. As shown in the annexed sketch map, it is found all over the northern half of the island where the land is low-lying and the rainfall comparatively small, while it hugs the eastern shores near which, owing to the more abrupt rise of the ground, the rainfall quickly becomes too heavy for *Palu*. In the poor soils of the arid zone the tree dwindles in size and usefulness. In the wet zone it is not to be found, although its first cousin, *Mimusops Elengi*, is found in the western province, but not of the same dimensions as it attains with a lower rainfall

Habit—In appearance Palu is not unlike an English oak. It has a large spreading crown, a straight sturdy bole with deeply cracked bark and more or less tufted leaves. These are, however, of a deep gray-green and the bark is of a much darker colour than that of the oak. In favorable localities it attains a height of 100 feet, with a bole 40 to 50 feet in height, but usually the latter does not exceed 30 feet. Trees 14 to 15 feet in girth are not unknown and I have seen logs about 13 feet in girth at the base, perfectly sound.

Soil—The best soil for Palu is a deep sandy loam, but it is found on almost pure sand, on gravelly soil and on clayey loams and, in the northern part of the island, on soil overlying fresh-water limestone. On poor soil it rarely attains a great size and degenerates into a small tree.

Companion species—Some Palu forests appear at first sight to be almost pure, but this is due to the large size and spreading crowns of the trees. It is associated in the upper tier with ebony, satinwood, Trincomalee wood, *Alseodaphne semicarpifolia*, *Vitex altissima*, while the lower tier contains large quantities of *Hemicyclia sepiaria*, *Nephelium Longana*, *Diospyros ovalifolia*,

Polyalthia coffeoides, *Pleurostylia Wightii*, *Walsura Piscidia*, &c., and the underwood consists largely according to locality of *Memecylon capitellatum* and *M. edule*, *Glycosmis pentaphylla*, *Dimorphocalyx glabellus* or *Stenosiphonium Russellianum*.

The number of trees per acre counted in eight different enumeration surveys varied for 1st class (6 feet and above) from 0·6 to 4·44; for 2nd class (4 feet 6 inches to 6 feet) from 0·02 to 6; for 3rd class (3 feet to 4 feet 6 inches) from 0·84 to 12·5; for 4th class (1 foot 6 inches to 3 feet) from 0·08 to 8·4; and for 5th class (2 enumerations only) from 0·08 to 1·97. It is a curious fact that trees of the lower girth classes are generally comparatively rare in high forests but are found more abundantly in old *chenas* (regrowth after temporary cultivation).

Sylvicultural requirements—The enumeration survey figures given above indicate that the tree does not reproduce itself easily under a dense leaf-canopy. The very appearance of the tree with its large crown, which it spreads out above its companions, shows that it likes to have light in large doses. It is therefore apparent that the seed fellings require to be made heavy. I have noticed that fellings in Palu forests are not generally followed by the appearance of a seedling crop of that species, although seed-bearers were adjoining the gaps made. This is probably partly due to the great irregularity of the good seed years, which are generally dry years, but I attribute it also to the following causes. The rainfall being slight the seed exposed to the scorching sun does not readily germinate, and, if it does, the tender seedling cannot stand the exposure, or it cannot force its roots through the tufts of dense *urry* grass which spring up on exposed patches. Moreover, the seed being edible and lying, as it does, in an exposed place, is soon carried away by animals; it is also removed by villagers, in large quantities, from the seed-bearers.

As mentioned above, Palu saplings are by no means uncommon in scrub forests; it follows that the young plant requires some low shelter and this is obtained in high forest by sparing the undergrowth, which protects the soil and conceals the fruit. Perhaps the best method of carrying on seed fellings is to girdle the trees adjoining seed-bearers. The seed ripens between May and July, that is, about 3 months before the burst of the N.-E. monsoon.

Rate of growth—Owing to the dark colour and compact and uniform nature of the wood it is not possible to gather any information from the rings of growth as regards the rate at which Palu grows. The natives say that the tree is very slow growing but, so far as the yet scanty information obtained from sample plot shows, it has on the average as quick a rate of growth as satinwood, and reaches a girth of 6 feet at breast-height when it is about 130 years old. If it is growing in suitable localities its growth continues vigorous until the tree is quite 8 feet in girth.

Timber—The wood of Palu is dark, varying from a dark vinous-red to purplish-black; it is extremely hard, dense and heavy. It possesses great strength and is particularly well suited for construction. The value of P. according to Skinner = 944. Its hardness has earned for it the name of Ironwood which it shares with *Mesua ferrea*. Its great drawback is that it is apt to split in seasoning. This can be, however, to a large extent, obviated by girdling the trees two or three years before they are felled, and thus allowing the timber to dry gradually. The seasoning can be carried on still further by burying scantlings under wet sand or by plunging them for about six weeks in fresh water. Palu timber thus treated is darker than when it is not girdled and it is also heavier. I weighed two pieces of timber coming from the same forest, one girdled and the other ungirdled, the former weighed 77·8 lbs. per cubic foot and the latter only 71·3 lbs. The weights of 5 specimens (ungirdled) from different parts of the island ranged from 67·6 lbs., to 74 lbs. per cubic foot, the average being 69·9 lbs. The heaviest specimen was from the northern province which produces some of the finest Palu. Curiously enough the colour of this northern province timber is almost as dark as that of girdled Palu in the north-western province.

The timber is extremely durable. In many of the old Dutch forts in the northern province there are door and window frames made of Palu. The old gates of the fort at Calpentyn (Kalpitiya) bearing the date 1761, and made of Palu, were only replaced by new ones in 1896. They were then still fairly sound but worn at the ends. Some old piles which were taken out at Mannar a few years ago and which were over 100 years old, were still quite sound below the water line.* The Chief Engineer of the Colombo harbour works is, at my instance, testing the durability of various Ceylon timbers as regards resistance to attacks of the Tiredo. Among other specimens put down towards the end of 1897 were pieces 8 feet 6 inches by 14 inches by 7 inches of Palu, both girdled and ungirdled. These unfortunately do not appear to have been kept separate. Of the 7 pieces put down, one only was "eaten one-third into it 18 inches up," the rest were either not touched or only slightly attacked. It would be thought that a strong and durable timber like that of Palu would be purchased eagerly for Railway sleepers but this is not the case. Relying on some old reports on sleepers made when the Railway was first started, the Railway authorities avoid all Ceylon woods excepting satinwood and milla (*Vitex altissima*), which can be sold more profitably to other purchasers. In the higher portions of the Railway, sleepers of Doona zeylanica and D. Gardneri are

*'Ceylon Forester' Vol. II. No. 6, page 121.

also somewhat grudgingly accepted. Sample consignments of girdled Palu were given to the Railway but they were lost sight of and the experiment was, in consequence, a failure. The timber is largely used by the Public Works for bridge planks and also, to some extent, for building; but teak being easier to work it is more generally preferred. A considerable trade with India is carried on at the northern ports, Palu being in much request for buildings in the southern portion of the Peninsula.

Notwithstanding its hardness Palu can be most beautifully carved. Some of the handsomest pillars of the Ceylon Pavilion at the Chicago Exhibition were made of this wood and the fine carved posts of the railing of the staircase at the Pavilion (Government House) Kandy, being also Palu. The wood takes a fine polish and should do well for ornamental parquet flooring. Some years ago Duke Henry of Mecklenburg paid a visit to Ceylon and was much struck by the beauty of polished girdled Palu. He ordered some logs of this wood for the steps and railings in the central hall of a new palace he was building at Schwerin, while for the panelling he ordered *Filicium decipiens*.

By-products—The chief of these is the fruit which is collected in considerable quantities by the natives who come from the adjoining islands, and even from the mainland of India, for the purpose. The fruit is exceedingly sweet and is eaten both fresh and dried. The collection of the fruit causes a great deal of trouble to Forest Officers, owing to the reckless manner in which, not only twigs and small branches are torn off, but even huge branches are lopped off, forming, when fallen, real fences round the trees which have been thus attacked. Watt, in his *Dictionary of Economic Products* quoting the *Baroda Gazeteer* says that the dried fruit is eaten by Hindus on fast days when cooked food is forbidden, and that in the hot weather the poorer classes eat it largely mixed with whey. According to Lisboa it is also said to be the chief article of food of the poorer classes of Gujurat during the hot-weather months.

The milky juice is used for cuts, bruises or boils, but it seems to have, as yet, little commercial value. Experiments have, as far as I know, not yet been made to ascertain whether gutta-percha could not be obtained from this tree as well as from other trees of the same natural order. Regarding the oil which is said to be compressed from the seeds and the gum, which this tree yields, so little is known that they deserve only a passing mention.

Enemies—After what has been said above regarding the collection of fruit from this tree, it can be easily gathered that man is its worst enemy, not only by causing direct injury by the mutilation of its limbs, but also by rendering the tree liable to attacks of fungi and insects. The wood is liable to the attack of a peculiar fungus which permeates the whole heartwood and gives

it a spongy or honey-combed appearance. If the tree is felled before the *fungus* ripens, *the timber is still fit for use; but in its* later stages the mycelium penetrates too thoroughly into all parts of the wood to let it be of any service and the wood soon crumbles into powder. A small insect (*probably* an *Ichneumon* fly) attacks the buds which take the shape of prickly ovoid bodies which are sometimes mistaken for the fruit.

A. F. BROUN.

A. F. BROUN.

Indian Trees.

I have lately despatched to some of my younger friends in India, copies of that portion of the book, which relates to *Papilionaceæ*, and it seems time now, to say something regarding the scope of this work

Colonel Beddome's excellent *Flora Sylvatica* was published from 1869 to 1873, and soon afterwards followed the *Forest Flora of Burma* by the late Sulpiz Kurz, and the *Forest Flora of North-West and Central India*. During the 25 years that have elapsed since that time, numerous publications relating to Indian trees, shrubs and climbers have appeared; many species have changed their names and new species have been discovered. Even that standard work, *Hooker's Flora of British India*, as far as the earlier volumes are concerned, is no longer up to date. Hence my wish to place in the hands of my younger friends in India a book, giving an account of the more important trees, shrubs, climbers and bamboos, as they are understood at the present time. It is limited to the British Indian Empire; Ceylon and the Straits Settlements are excluded.

When I commenced the work several years ago, I intended to limit myself to the more important kinds. As the work progressed, I found the selection of the species, which might be omitted, exceedingly difficult, and I came to the conclusion, that the usefulness of the book would be greatly impaired by such limitation. I pictured to myself one of my younger friends in Burma. He has come across a tree, which he thinks is a *Dalbergia*. Now, if the book only gave a description of *Dalbergia Sissoo*, *latifolia*, *cultrata*, and perhaps also of *ovata* and *paniculata*, he would feel uncomfortable, for he would soon see that his tree is not one of these. He would have to consult Dr. Prain's excellent paper in the 66th volume of the Bengal Asiatic Society's Journal, in order to find out that it is *Dalbergia Kurzii*, Prain, which Kurz erroneously described under the name *D. purpurea*. In the same manner he might possibly succeed in identifying another tree of the same genus as *D. Oliveri*, Gamble. But Forest Officers are not all members of the Asiatic Society of Bengal, and if they were they could not carry the volumes of the Journal about with them.

My ambition is to make the book a path-finder through the immense variety of trees, shrubs, climbers and bamboos, which constitute the forests in the different provinces of India. I do not maintain that Foresters ought to know them all, but they ought to have the means of making themselves acquainted with them without undue loss of time. If my book accomplishes this I shall be much gratified. Quite unexpectedly a shrub, a climber, a bamboo or a tree may be found to be of considerable importance from a Forester's point of view, and he should then have easy means of finding out all about the species in question.

Though I have not limited myself to a selected number of species, I have given more full descriptions in larger type of all common and (as far as known at present) important species, and have dealt with the others in a more summary manner in smaller type. My Botanical friends at Kew do not quite like this arrangement. From their point of view all species are equally important and ought to be treated alike. The book, however, is not intended to be used by Botanists; it is written for the use of foresters only, and for foresters those species, which are common, or which play an important part in the life of the forest, or the produce of which is marketable, those species are infinitely more important than the others. These, therefore, have been dealt with in a very summary manner. Species which are doubtful or are imperfectly known I have omitted altogether.

My sole object in undertaking this great work has been to help Indian foresters. Some of them I fear may say that Dr. Brandis, by publishing this handbook, has managed to impose a new and intolerable burden upon us miserable foresters. As it is, our life is difficult enough, and now, in addition to all our troubles, we are expected to study this new Botanical Handbook. Indian foresters have many grievances. Our pay is too small, our prospects of promotion are bad, we have not the rank and the social position which we ought to have, and when we attempt to manage the estates entrusted to our charge in accordance with the rules of our profession, the Civil Officer comes and interferes with us.

Obviously, what is wanted is to raise the status of the Indian forester, so that he may be more respected and that his work may be valued more highly. Now, I am far from maintaining, that this will be effected by a more perfect knowledge of the trees, shrubs and bamboos which constitute the forests in his charge. Yet, I maintain, that the acquisition of such knowledge will be a step in the right direction.

Forestry is not a national English profession. The English, whether in Great Britain, in the Colonies or in the United States of North America, are eminently practical; that is, they aim at tangible and immediate results. My best friends in England, men, who take a deep interest in the welfare of the British Indian

Empire, and who are personally attached to me, measure the success of forest administration in India almost entirely by the net annual revenue which the forests yield. When that revenue diminishes, as was the case some years ago in the Central Provinces, such decrease is regarded as certain evidence of bad forest management. The real objects of rational forestry, the maintenance and gradual improvement of the productiveness, the yield capacity and capital value of the forests, and in India specially, the utilization of waste lands for the production of fuel and cattle fodder, these objects are hardly yet understood, or if understood, they are not sufficiently appreciated.

Accordingly, it is but natural, that the essence of forestry should be sought for in another direction. And, as foresters have to deal *with trees, shrubs and bamboos*, it has come about that in England, Forestry is commonly regarded as an appendix to Botany, and that a forester, who is not a Botanist, is supposed not to have any claim to the name of a scientific man. Doubtless Botany is one of the sciences upon which rational forest management has been built up, but it is not that kind of Botany, which those, who demand that a forester must be a Botanist, chiefly cultivate. That branch of Botany merely deals with the outward characters, the systematic arrangement and the nomenclature of genera and species, and has very little to do with those branches, which are of real importance to the forester, the life-history of plants, their nutrition, their mode of growth, their relation to light and shade, the diseases to which they are subject, and the enemies which interfere with their development. It has been officially stated by a high authority in this branch of the science that systematic Botany enables a forest officer to fill a somewhat higher rôle, than that of a timber merchant, a dry salter or forest policeman. These friends of forestry ignore completely, that the other and higher branches of Botany are far more important to the forester, than what in England is as yet commonly understood as systematic Botany, and further, that Mathematics, Geography, Chemistry and Meteorology are fully as important to the forester as Botany.

The handbook, however, which I hope in due time to present to my younger friends in India, mainly deals with the outward characters and the systematic arrangement of the species which constitute the Indian forests. Had I attempted to set forth fully, as I should have wished, what is known regarding their anatomical structure, and the biological peculiarities of these plants, the work would have become unwieldy. While thus compelled to limit myself to the less important part of the subject, I have been comforted by the hope, that the book may tend to enable foresters in India to hold their own among Indian Botanists. It surely is not necessary, that foresters should be descried as ignorant men, because, on the authority of Kurz they

speak of *Dalbergia purpurea*, when they ought to call it *Dalbergia Kurzii*, Prain, or because they follow the Flora of British India, in regarding *Pterocarpus indicus* and *dalbergioides* as one species.

As regards the present generation of foresters, it certainly rests with them, and with them alone, to raise their own status. They will accomplish this slowly but surely, not by writing sensational reports, calculated to meet the fancies of those who are placed in authority over them, but by steadily working upon the lines laid down by the principles of their profession, thereby conferring inestimable and lasting advantages upon the millions who inhabit the British Indian Empire. To future generations this task may be made easier, by entrusting to an English University the task of training foresters for India.

For all it will be an advantage to have facilities for making themselves acquainted with the trees, shrubs, climbers, and bamboos, which constitute the forests in their charge. A good knowledge of the species is the first step towards the more important study of their internal structure, of their biological peculiarities, and of their requirements. My handbook, therefore, is only intended to teach the first elements of Indian Botany. Should I succeed in carrying out this, my intention, I shall be most thankful.

Those who may take the trouble to examine the portion of the book now circulated, will find that in selecting the species to be illustrated, I have gone on the assumption, that common species, such as *Ougeinia*, *Erythrina indica*, *Butea frondosa*, *Sissoo* and *Blackwood* are known to every Indian forester. Among the others the selection was not always easy. I had to limit myself to 200 illustrations, and I hope that 600 pages will suffice to complete the work.

D. BRANDIS.

July 1900.

... Griffith

Diospyros mollis, Griffith.

This name I have provisionally given to a Burmese species of Ebony, which has puzzled me a good deal lately, when working up the species of *Diospyros* for "Indian Trees." I should be glad to get more specimens and information concerning this species before it finally makes it appearance in my Book. Griffith describes it, from female specimens, in the Journal of the Agricultural and Horticultural Society of India, *III*, 145. Kurz (Forest Fl. II. 180) evidently had both sexes before him. I have only some male specimens, and until I have seen female flowers and fruit, cannot be quite sure of the identification. It is not mentioned in the *Flora of British India.*

The specimens I have examined are from the following localities :—

1. Yoonzalin, D. B. 3500 ft. March 1880, a large tree, fl. pink.
2. Mogok, E. M. Buchanan, 4000 ft. April 1888, fl. April, May; fruit ripens towards the end of rains. Local name *Tayok-Tè.* (Chinese Ebony.)
3. Manipur, Dr. Watt, 3-4000 ft. April 1882. No. 6264.

Kurz gives it from Ava and the Kakhyen hills, and states that it is frequent in the drier hill forests of Martaban, also that the berries produce the so-called black dye of the Shans.

The male specimens examined by me have the following distinguishing characters. Branchlets, petioles and underside of young leaves rusty-tomentose. Leaves elliptic, lanceolate, upper side, when full grown, with scattered hairs, blade 3-4, petiole $\frac{1}{3}$—$\frac{1}{2}$ in., secondary nerves 4-6 pair. Male flowers in small compact axillary cymes, sessile or on short peduncles, flowers generally tetramerous. Calyx deeply 4-cleft, lobes triangular, tomentose on both sides; corolla in bud globose, with a pyramidal hairy apex, otherwise quite glabrous. Stamens 16-24, anthers linear, apiculate, hirsute, as well as the short filaments. The fruit Kurz describes as globose, the size of a largish cherry, somewhat depressed and umbilicate at the apex, smooth, surrounded at the base by the indurated calyx, usually one-seeded; albumen homogeneous.

D. burmanica, Kurz (Tè) the Ebony of the Eng forest, has elliptic-oblong leaves, shining above, secondary nerves numerous but indistinct, flowers pentamerous, corolla densely tomentose outside, stamens glabrous.

D. BRANDIS.

We trust our readers will respond heartily to the appeal made to them by Sir Dietrich Brandis in this and other papers. Specimens and information should be sent direct to Sir Dietrich Brandis. Address.—Up to 31st October next, Bonn, Germany. 31st October 1900 to 30th June 1901, Capel House, Kew Green, Surrey, England.

HON. ED.

Notes on Terminalia tomentosa.

In reference to Mr. Leete's note on the above in the "Indian Forester" for June, the growth of this species has passed through three stages in the Oudh forests.

First stage.—The forest annually burnt, impossible for seed to germinate save in those localities which escaped fires, in consequence the tree represented in perfection in lowllying areas and along the drainage lines and banks of lakes.

Second stage.—The forests protected from fire, the above restriction removed and immediate spread of the species over the ruined sal forest.

Third stage.—Continued protection, recovery of vitality in the sal forest, renewed suitability of the soil for sal reproduction, intolerance and defeat of other species by the triumphant sal forest

The final stage will happily be the relegation of the asaina to those localities where the conditions are adverse to the reproduction of sal, in fact probably to those areas where only in the time of annual fires, its existence was possible.

It is interesting to recall the theories of the past in connection with this tree. During stage I we thought and said that the asaina preferred lowlying, moist, even water-logged soils. We were wrong in mistaking necessity for preference.

During stage II we feared and repeatedly said so, that the asaina would oust the sal from our forests. We were wrong, for there is no tree in those forests which responds with more vigour to protection than the sal, though it may have to wait longer than other species before soil and other conditions become suitable.

Arriving at stage III we fear that the tree may become extinct in fire-protected forests. Again we are wrong; it will continue to exist in such localities as the dominant and more valuable species cannot utilize.

When the final stage is reached we shall have peace, for even then there will be sufficient *Terminalia tomentosa* available for all useful purposes. The value is more theoretical than otherwise, no one will use the timber knowingly if they can afford better, it is of service in adulterating the stock of scantlings and sleepers stocked in the native timber market, but this should not be encouraged. In fire-protected areas it is a pest on account of the obstinacy with which it smoulders, though this drawback has also its advantages in that the debris of its fellings disappear totally, so soon as an area is burnt over.

I have in this short note expressed myself with the certainty I feel in the matter. Mr. Leete has remarked on the coincidence of the establishment of fire conservancy and the disappearance of asaina reproduction. He is right in connecting the two facts, but the latter is only an *indirect* result of the former. Fire conservancy favors the reproduction of asaina, as proved by Stage II of the forest growth but, *provided the protection is continuous*, the sal responds ultimately much more vigorously to the care afforded to it.

S. EARDLEY-WILMOT.

Classification of Government waste lands in the Bombay Presidency.

The re-classification of the lands administered by the Forest Department in the Bombay Presidency first came under consideration towards the close of the year 1893. A Government Resolution was issued in September of that year, and circulated to the Press for publication. In this Resolution, No. 6702, dated the 15th September 1893, the Local Government issued instructions and suggestions regarding the regulation of grazing in Reserved forests, and more especially regarding the proposed re-classification of the forest lands.

It is therein stated that "forests" are to be divided into 3 classes:—(1) Forest proper; (2) Fodder and fuel reserves; and (3) Pastures; and the lines which are to be followed in selecting areas for these different classes of forests are very clearly laid down in the following paragraphs of the Resolution above-quoted.

"*Forest proper* should be limited to areas which it is desirable to keep under scientific departmental management, with a view, primarily, to the preservation or creation of timber or fuel growth. Outlying tracts which are not wanted for scientific development should not be included in forest proper, merely because they contain a certain quantity of bush or tree-growth which can be protected sufficiently for local needs by occasional closure and such simple measures of conservancy as are within the competence of the Land Revenue Department. Nor on the other hand is it necessary that patches in the middle of tracts, generally suitable to be classed as forest proper, should be thrown out because they happen to be comparatively bare. In the same way promising plantations occurring in the midst of tracts generally classable as pasture may be left to be put under suitable management by the Collector without classifying them specially."

"The class *of fodder and fuel reserves* will be practically limited to existing kurans and plantations, with possibly a few additions in places where they are wanted and the conditions are suitable. No land which does not produce grass of good quality, of a head suitable for cutting, should be reserved. Usually, of course, the quality of the grass will be estimated with reference to its suitability for *fodder*, the coarse descriptions which cattle will not eat being excluded. But where there is a special growth of any particular variety of grass or valuable rush, like munj grass in Sind, for other purposes, such as thatching, basket work, matting or tatties, which seems likely to disappear if not protected, it may be desirable to establish a reserve."

"*Pasture* should include all reserved land not taken under one of the other two heads."

Moreover, "if real and rapid progress is to be made, it must be by concentrating effort to begin with on a suitable number of comparatively small plots selected where the conditions are least unfavourable, and where careful artificial treatment can be applied with some chance of a tolerably quick response." "If this principle be followed, it is probable that a very large proportion of the land now supposed to be under reboisement in the Deccan districts may be classed for the present as pasture, and the forest establishment employed on it set free to deal effectually with a more manageable task."

As regards management the chief points for consideration were :—

(a). What measures for the preservation and improvement of the grazing in pasture are desirable and practicable.

(b). By what agency can they be carried out.

After the lapse of four years the reports called for in Resolution No. 6702 dated 15th September 1893 were submitted; and Resolution No. 1668 dated 8th March 1898 was issued.

The principles upon which the re-classification was then carried out are given as follows:—"the claims of cultivation are stronger than the claims of forest preservation, and that wherever an effective demand for culturable land exists, and can only be supplied from forest areas, the land should ordinarily be relinquished without hesitation." So much so that—"in many cases plots of culturable land within the demarcation line could be, with great advantage, given out for occupation on condition of the holders watching the surrounding forests."

Accordingly, in the classification finally accepted, it was decided that only such areas as actually contained forest should be classed as *forest proper*, and "no area could be held to contain forest which has not at least 20 useful trees to the acre"—the rest must, for the present, be classed as pasture, subject to future conversion into forest proper when means are available. The forest proper being classed either as (1) Forest proper, or (2) Fuel and fodder reserve, according as to whether it is to be worked for fuel or timber. Moreover, fuel and fodder reserves should not be opened to grazing at all, except in very special circumstances.

"The rest of the forest area must for the present be classed as (3) *pasture*; but it will be open to the Forest Department, at any time when it is in a position to do so, to convert any part of the pasture into either forest proper or fuel reserves, so far as this course can be followed, without interfering with the reasonable supply of local needs."

Now, as regards the system and agency of management. "All forest proper, whether they yield timber or firewood, or consist merely of scrub jungle protecting the slopes of hills must, of course, remain under the management of the Forest Department. That Department should also have charge of all

fuel reserves, or mixed fuel or fodder reserves, except such as are so far removed from the forests proper, that the superior officers could not exercise effectual supervision without prejudice to more important duties. The production of grass does not require the services of a scientific Department and pure fodder reserves should be in the charge of the Revenue Department. It must be remembered that the produce of all these reserves must be devoted, primarily, to the supply of local wants at reasonable rates, and only the surplus, after these wants are fully met, may be exported." Lastly, as regards the areas classed as pasture, "the transfer of these areas to the Revenue Department is the only effectual method of remedying an evil too long continued." As already stated, however, "opportunity will be given to the Forest Department to convert into either forest proper or fuel reserves any parts of the pasture area which are suitable for the purpose, provided there remains a sufficient area open for pasture," *and provided the Collector assents.*

As regards grazing inside the "forest proper," "the present practice as to admission of animals will be continued until experience shows need for modification."

On the other hand, "the management of the pasture areas should be left, as far as possible, to the people. But they should be advised that it will be for their advantage to confine sheep and goats to waste lands, which will profit from their droppings, or to specific portions of the other area, and to close, periodically, parts of the pasture area, particularly in the months of June and July. The privileges hitherto enjoyed of utilizing such trees and bushes as grow on the pasture area will be continued, but the people should be warned that the destruction, instead of mere lopping, of the trees or any other wasteful practice will be, eventually, to their own disadvantage."

So far we have merely quoted, (as far as these have been published), from the orders and resolutions issued for the guidance of the officers engaged in drawing up proposals for the re-classification of the Government forest areas in Bombay. To sum up, it will be seen that the procedure to be followed amounts to this, namely, that all well-stocked areas of sufficient size, and conveniently situated, are to be maintained as Forest reserves, to be classed either as reserves proper, or as fuel and fodder reserves, according as to whether it is decided to treat them as high forest or as coppice

The remainder of the area is, for all practical purposes, to be *excised*. This is not the word used, and, indeed, we are quite prepared to meet the argument that there is no intention whatever of definitively applying for the sanction of the Government of India to the excision and deforestation of the pasture lands: but a perusal of the orders on the subject, and the procedure now being followed, will clearly show that to all intents and purposes the areas are disforested.

To recapitulate, it will be seen that the so-called *Pastures* are to be altogether removed from the control of the Forest Department. These are, in future, to be in the charge of the Revenue Department ; but their management should be left as far as possible to the people themselves. These areas should be sufficiently large to fully meet all the local demands likely to be made upon them. And last, but not least, the Collector has perfect power to give out the "pasture" lands for cultivation, and this power is being freely made use of in many cases. On the other hand, it has been stated that an opportunity will be given to the Forest Department, at a future date, to convert certain portions of the pasture lands into reserves, provided—

(*a*) The Collector assents.

(*b*) The area is suitable for the purpose.

(*c*) This course can be followed without interfering with the reasonable supply of local needs.

(*d*) There remains a sufficient area open for pasture.

How far then it may be expected that the areas classified as "pastures" are ever likely to come under any kind of forest conservancy we must leave our readers to decide. We would merely add that the Bombay Government itself apparently shares our own misgivings when it writes:—"unrestricted use by the people necessarily involves the complete destruction of such forest-growth as at present may exist on the land, and makes the work of restoration to a forest or fuel reserve almost impracticable."

If then we consider the areas classified as "Pastures" as excised or disforested, whether temporarily or permanently is a matter of small importance for the moment, it remains to consider what is the area of forest at present set aside in Bombay for the production of fuel and timber, and how this area compares with the total area of the Presidency under cultivation or devoid of tree growth.

The figures in the last review of Forest Administration in British India, 1897-98, give the distribution of the forests of the Bombay Presidency as follows :—

Province.		Areas under management of the Forest Department.			Proportions of Forests to whole area of Province.
Name.	Area in square miles.	Reserved.	Protected.	Total.	
Bombay.	123,048	13,281	1,631	14,912	12·11

It will thus be seen that the area of woodlands is only 12 per cent. of the total area of the Province, and consequently on this ground alone, the excision of any area is undesirable. It should be remembered that the original selection, settlement and demarcation of the forest areas was carried out at a tremendous cost, wholly by Revenue Officials, unhampered in any way, and determined to set aside only such areas as were in every way suitable for afforestation. Consequently, very strong grounds should be made out before the disforestation of any of these areas can be considered expedient. Not only this, but Prof. Voelcker who was specially asked to report on the forest area in the Bombay Presidency declared it to be ridiculously inadequate and recommended a large increase.

The total area to be set free amounts to 600 square miles; but 555 square miles, or 355,200 acres are situated in the Central Circle and it is consequently in that part of the Province that the question becomes one of great importance, and our remarks must apply more especially to those areas.

The lands disforested in the Central Circle are mostly situated in the Deccan, an arid country, where the proportion of forest to barren areas is already in all likelihood nearer 5 per cent than 12 per cent, the percentage for the whole Province. In fact, just where the need of forest is greatest, there the disforestments are heaviest. This is largely, no doubt, due to an idea that forests cannot be grown there, supported by the argument that the results of 20 years' protection are invisible. To any one who knows anything about the question, the results are very far indeed from being invisible; and, moreover, the fact must not be overlooked that the Department has had to contend against innumerable difficulties, trespassing and illicit grazing: difficulties, which have been rendered all the greater by the ineffective and impracticable nature of the protective rules it has been thought to enforce. It is to be hoped that the question of returning many of these areas to the Forest Department, with a view to their early re-afforestation, may receive serious attention.

C.

Notes on destructive insects in the Goalpara Division, Assam.

The last note on this subject was embodied in Mr. Campbell's remarks on "Natural Reproduction," in the Annual Report of 1897-98, published as an appendix in the Circle Report of that year.

It is satisfactory to remark that there has been no repetition of the complete and general defoliation of sâl described by Mr. Campbell. During the first year, 1898-99, defoliating caterpillars made their appearance in nearly all the forests, but the attack was confined to small scattered patches, seldom extending to more than 30 or 40 trees in any one place. In these, however, the trees were generally completely stripped of foliage.

The Guma reserve, and the Sidli Working Circle of the Chirang Reserve appeared to contain the largest number of defoliated patches. The caterpillars mostly found were Dasychira, generally the Thwaitesii, but it was by no means easy to ascertain the culprit out of the host of insects to be found in the forests at all times. It is more than probable that destructive insects were evenly distributed throughout the forests, but in small numbers. The damage was, however, limited to the small groups of trees previously described. A curious result of the defoliation was that the sâl put out its new leaves, almost immediately after the cessation of the attack in the cold season, instead of at the commencement of the hot weather. In December and January, small patches of sâl in new leaf formed a peculiar feature of the landscape and contrasted strangely with the surrounding winter foliage.

Closely connected with the attack by insects is the success or failure of the seed development. The spring of 1899 was favourable in every way to the inflorescence of sâl, and a bumper seed crop followed. The seedlings have developed well and a careful inspection during the last open season revealed their presence in all favourable localities. In some places, there were actually three generations on the ground; (1st) the mother trees, more or less scattered; (2nd) a dense pole growth, ten to twenty years of age; and (3rd) the new seedlings at intervals of a few inches. Of course, the youngest generation will disappear, but it will be interesting to note how long they are able to survive in the dense cover.

In the spring of the current year (1900), sâl again gave signs of flowering but at that time, the first indications of an insect-attack on a large scale became evident. A succession of severe hail storms with cold weather, destroyed the inflorescence, but the hail proved equally destructive to the young caterpillars. In Guma, the hail storms were not so severe as in other places and the caterpillars were only partially destroyed, defoliation is now in progress but on a small scale. The severity of the hail storms may be gauged from the fact that the new grass was cut down to ground level and soft-barked trees (*e.g.*, Albizzia) were stripped on the side exposed to the wind.

DHUBRI, ASSAM. W. F. PERRÉE.

The Mechanical extraction of Rubber.

As set forth from time to time in the *Revue des Cultures Coloniales*, the French are making progress in the extraction of rubber from various kinds of bark. M. M. Arnaud and Verneuil are advocating a cheap and easy process of extraction by simply pounding and levigating the dried bark in hot water. The latex of the Brazilian Hevea and of the Central American Castilloa flows easily and abundantly, but that of other rubber-plants coagulates almost immediately on incision, stopping further supply and leaving most of the latex in the bark. This is the case with Landolphia, an African climber, which, nevertheless, provides one of the best and purest kinds of rubber.

Many attempts have been made to extract the rubber by means of solvents, like benzene and sulphide of carbon, acting on dried and powdered bark. But these solvents have to be used in large quantities, and the resulting rubber is found to have lost some of its tenacity and, consequently, a part of its commercial value. No such process appears to be in practical use.

Other attempts have been made in the direction of disintegrating the bark by means of acids or alkalis, so as to liberate the rubber. M. Deiss, for instance, treats the bark of Willughbeia in Malacca with concentrated sulphuric acid, but the process appears to be too costly for general adoption.

M. M. Arnaud and Verneuil recommend a purely mechanical treatment for Landolphia. The dried bark is powdered in a mill or mortar, and sifted to get rid of 40 or 50 per cent of the bark. The rest, partly agglomerated in sheets, is soaked in hot water and again pounded. The resulting plastic and friable paste is again sifted in hot water. The mass remaining in the sieve is now seen to contain many whitish filaments of rubber. The process of pounding and sifting is continued until the formation of a spongy mass, which is mostly rubber. To get rid of adhering particles of bark, the mass is thrown into boiling water. The rubber, being lighter, floats on the surface and is easily gathered up. It is then beaten into sheets of almost pure rubber. The final purification is effected by passing the sheets between two rollers revolving at different speed, so that the sheets are stretched and pulled about, and release the last remaining particles.

The outturn from Landolphia is very good. The aerial bark yields 8 or 9 per cent of rubber, while that of the roots gives 14 or 15 per cent. American Hancornia bark gives over 5 per cent. Solvents give no greater results and their product is more or less contaminated with resins and grease.

Dr. J. A. Henriques of Coimbra brings to notice the fact that the idea of obtaining rubber by drying and pounding the bark is not new, being used by the Benguela tribes of western Africa in the case of *Clitandra* and *Carpodinus*. These plants

have long subterranean stems. By drying and pounding these in water the negroes obtain a good pure rubber. The adoption of the improved procedure of M. M. Arnaud and Verneuil appears all that is necessary to obtain commercial success on a large scale.

V.—SHIKAR, TRAVEL, &c.

West by East.

I suppose one has to take furlough when one gets fever more frequently than is comfortable. It is a nuisance having to store one's kit, and get rid of one's ponies and other animals which one

cannot store, and then comes the question of where to go? "Home," says the Griffin. However one's object is to miss the hot weather out in the east and yet dodge the British spring. The poet may yelp "Oh to be in England now that April's there," or words to that effect, but I have been there. Taking this and other things into consideration, such as the relief of travelling in steamers in which the rice and timber trade are unknown and the cry of the heaven-born is not heard in the smoking room, I decided to try going home *via* Japan and Canada. My experience may be of interest to other Forest Officers, so with the Editor's permission I will hold forth. Well, I started from Rangoon for Calcutta; this does not seem to be the shortest way to Singapore; however, I had to go to Calcutta on business. Arrived there I made enquiries about steamers and found that one of Jardine Matheson's boats was to leave for Hongkong about the time I wanted to start, so I took a passage in her, getting my ticket at Cook's direct to London *via* Hongkong, Nagasaki, Kobe, Vancouver and New York; the damage was Rs. 1,185 if I remember right. Now here comes in the first warning. I would strongly advise others not to take the ticket for the whole journey at once; it's no cheaper and it ties one down; also, I notice, that if one has one's money in one's own pocket Steamship Company's agents are very much more polite than if they have your money in their pocket. I started gaily down Garden Reach at the end of February and after an uneventful voyage we anchored in Penang harbour; the ship was at once boarded by the medical authorities and placed in quarantine for one day as we had sailed from an infected Port. The M. O. had failed to bring a newspaper on board and, considering it was war time and exciting events were going on, I did not feel like a brother towards him. The Officers of the ship and one passenger next day went shooting up some creek outside harbour limits. I declined to go when I saw the armament of the boat's crew and I was very glad as events turned out; the boat did not get back till 11-30 at night and the one unfortunate passenger who went got all the skin burnt off his face from the terrible glare of the water. And the bag? One alligator, about 8 feet long from nose to the very end of his tail and a job lot of paddy birds. The next day we were allowed into Penang, and all I can say is I was jolly glad to get out again, a slow one-horse hole with a climate! "Well," an American remarked, "this place is as hot as the hinges on the gates of Hades," and that about described it. A short run of two days and we sailed into the famous Singapore harbour. I have now seen about four harbours which all claim to be the finest in the world and Singapore is one of them. We were two days loading and unloading and it rained the whole time. I drove off to see the famous gardens; they are pretty but nothing to kick up such a fuss about and one thing quite spoilt my enjoyment, that is the Zoo. Of all the disgraceful exhibitions I have ever seen the

Singapore Zoo is the worst; the wretched animals are confined in cages in which they have hardly room to turn round in; there is absolutely no excuse for this considering the large ground space at the disposal of the authorities, and if it's a case of want of cash then in the name of charity sell or shoot the wretched inhabitants of the cages. There were five miserable muntjacs in an asphalt-paved cage about as big as a dining room table; again there were baboons in cages in which they could hardly stand up in; besides this the animals look neglected. I saw one sambhur with a huge sore in his side into which one could put two fingers. It is interesting to notice the great difference between the Malay and Indian sambhur, the former is not much larger than a good-sized Burmese hog deer. From Singapore a very rough run of six days brought us into another of the finest harbours in the world, Hongkong to wit. The view coming in is magnificent, the rock towering up to the flagstaff, lined with beautiful houses wherever one can get a foot-hold; then the harbour crammed with the shipping of all the countries of the world, from the Chinese junk up to the lordly British Flagship. It was a delight and a treat to be alive as one was hurried through the shipping in the neat launch belonging to the Hongkong Hotel. From Hongkong eastwards one finds *Hotels*, not the doss houses which masquerade under that name through the length and breadth of British India. I found I had just missed my connecting steamer to Japan, but the first breakfast at the Hotel made me feel inclined to stay on indefinitely. Unfortunately the most filthy weather set in and lasted the whole week I was in Hongkong; people talk about the lovely and wonderful view from the flagstaff! I saw exactly 10 yards into a mist, own brother to any one to be seen any cold weather in Upper Burma. However, I thoroughly enjoyed my week. One night I went to the Chinese theatre; the play was the lord knows what, and the orchestra was playing a tune that only the old gentleman could have been answerable for the score of—and the whole show was like any other eastern play, interminable bo-h! But the audience, Cæsar! One has seen crowds in India, but ten thousand pigtails packed as tight as possible into a huge building and all kept in order by 2 policemen—Sikhs (or Sicks as an American friend called them)! We took a box in which about a dozen Chinese ladies were packed, so got a very good view of the fair sex of the Flowery land—looks were quite enough. For a description of the steam tram and the effects one gets from looking out of the windows I will ask all your readers to recall the last time they were on a big *bust* and had been looking at the wine when it was pink and blue and every other colour. The way the houses and trees looked then is just how they look when one takes a journey up in the Hongkong tram. I am sure every one will now know what I mean so we will proceed to other pastures.

The best trip perhaps of the trip round, and one on no account to be missed is the trip up to Canton. I would advise going by day as one can then get a good view of the harbour, river up to Canton, and the tieing up to the shore on arrival. The steamers are excellent, the "chow" is good, and the captain with whom I travelled the best of good fellows, and a walking encyclopædia of information on China and he was kind enough to point out all the interesting sights *en route*. Go forward and look over the bows and you will be rewarded by seeing the extraordinary white porpoises which frequent the Pearl river. Every now and then one will race the steamer, sometimes swimming for as long as 10 minutes just in front of the bow; it looks as if every second the steamer was just going to run the fish down. At the forts at the mouth of the river there was some sort of inspection parade on as we saw the local Lord Wolseley, being carried in a chair, inspecting the troops. Going up the river the pagoda, which is supposed to have been taken as the model of the one at Kew was pointed out, except that the Kew people put an even number of stories instead of an odd number, which of course is what all Celestial pagodas contain. We passed the village famous for producing the best fighting crickets in China and in the afternoon anchored in Canton. Guides at once swarmed on board and we engaged the old original Ah Cum, and then sent our things and followed to the Victoria Hotel Shameen *i.e.*, the Europe quarter or concession of Canton. There was a cold drizzle on, which continued all next day, so things seemed a little dismal. In the night we were startled by three times being awakened by the sound of cannon, the reason according to Ah Cum was that the Viceroy should be certain that the guards were awake whilst the room-boy told me it was to frighten devils.

The whole of next day was spent in viewing the wonderful pigtail warren yclept Canton. We were carried in chairs through a maze of narrow streets from temple to execution ground, thence whisked of to the local Burlington Hall where the future civil servants as examined, tiffin in a pagoda, more temples, shops, and thence back to the hotel to pay our bills and catch the night boat back to Hongkong. The trip is a splendid one and should on no account b missed. At last the Pacific Mail Steamer was ready to start. An American friend who had come over in her from Frisco condoled with me in having to travel in her as he said: "Sir, she wo'd roll in a dry dock and I guess before I had been two days out I threw up everything except my tour round the world." However, being a good sailor, I dumped my kit on board, as the continual drizzle of Hongkong was giving me a tired feeling and a drive to the Happy Valley and contemplating the tombs (the only drive in Hongkong) is not a cheerful recreation, taken daily. Two days saw us at the mouth of the Shanghai river and a tug came down to take passengers up

to Shanghai. I was in doubt whether to go or not and expressed it to the Chief Engineer, the first I have ever met who did not hail from the Clyde. He was horror struck at the idea. "Not see Shanghai while in the locality? Why, Sir, it's the Chicago of this section!" As if one was travelling to see *Chicagos of this or any section.* I went, with the result that a fog came down almost as thick as a London particular, so I saw "d—all," as the colonials say, with the pleasure of next day spending about 4 hours on the tug while she hooted in the river vainly looking for our ship. Another two days and we sailed into Nagasaki Bay, another of the finest harbours in the world. The most prominent sight was a huge advertisement in Jap characters on the hill side of a brand of cigarettes. The ship had to coal here so we had time to take a rickshaw ride to Moggi, about 1½ hour's distant, through lovely scenery, the cherry trees were in flower, the sun was shining brightly. Nagasaki was full of quaint little Japs, everything was new, strange and fascinating; we had lunch at the Moggi tea house and then came back to the ship to find that the coaling had been completed by the swarms of Jap girls who form long strings from the barges to the bunkers, and throw little wicker baskets containing a ridiculously small amount of coal from one to another. They laugh and chatter the whole time, but yet pour the coal in at an astonishing rate only being beaten in the world by the black ruffians at Port Said. The Nagasaki coal is clean so coaling is not the misery here that it is at Port Said. Next day I woke up to find the ship speeding through the famous Inland sea. Now this, like almost everything else Japanese, from the Jap girl to the Diabatsu at Kioto is overrated. If Murray struck 50% of the adjectives out of his guide it would still give one an exaggerated idea of Japan. It is absurd to write as if Japan was an earthly paradise! It's not. The scenery is nothing more than can be seen in hundreds of other tourist resorts; the Jap girl—well a thing with a caricature of a figure, no features to speak of (three kicks in a mud fence would decribe them), who tires one with a continual and senseless giggle and with the manners of a spaniel dog. Similarly, people expected me to rave over every wretched pagoda I saw. Great Scott! After one has seen the Shwe Dagon at Rangoon, the wilderness of Pagan and the hundreds of lovely Pungyi Chaungs scattered over Burma. Or, I would be dragged off to see a Diabatsu, *i. e.*, a colossal image of Gaudama, made of wood if you please and hollow at that, a sham, and I had seen the gigantic stone image in Burma. The pagodas! A decent Buddhist from Burma would not know he was in a temple of his faith. Plant him down in any temple in all Japan; he would be horrified by seeing hideous images with hundreds of hands and millions of toes, and told they were kwan-non, gods of fire, good luck or peradventure pain in the stomach.

The Jap man is insufferable; his politeness is the merest surface veneer; rub him up a little the wrong way and you soon find that out; and the whole nation, since the war with China, is suffering from the most appalling attack of swelled head you ever saw. My advice to any one going to Japan would be to land at Kobe, make straight for Kioto, see all that's to be seen there, a week is ample, go thence straight to Nikko, spend three days there and then to Myanoshita, a week there, and then light out of the country. One will then have some chance of coming away charmed with it. I was too ambitious. I heard the usual stock of lies about Japan. I had read many guide books and dozens of others to boot, and I spent 7 weeks in the country steadily pounding from one sight to another and doing everything till the day my steamer was ready to start; and then, you bet, I was waiting on the Yokohama bund at dawn so as not to miss the tug. "I had got cold feet," as the Yanks say. Above all things avoid guides; they are absolutely unnecessary and a fraud. Murray says otherwise but I didn't know a single word of the language, and yet worried through all right and saved about three dollars a day. The rickshaw men are a very intelligent lot; get hold of one at each place, who has taken tourists round, and he will know exactly where you want to go; a great many know a very fair amount of English too. I met two English ladies travelling alone and they did not find a guide a necessity either.

Well, to resume. I landed at Kobe, and then went on to Osaka; I had found my enemy; it is here that that spawn of iniquity, the Jap match, is hatched. One can see the process in a thousand streets; I had tested the finished article, I had no desire to know how the evil thing was made. We went to Osaka to see the famous castle; the Jap is very like the Frenchman in many ways and is now suffering from Spymania, so photographers beware. The castle, what one is allowed to see of it, is very interesting and from the gigantic stones forming its ramparts we can get a fine view of the town and also of battalions of Jap soldiers going through military exercises, Osaka being a very large military head-quarters. The soldiers are a sturdy lot, not unlike Goorkhas in appearance, but the cavalry! The horses would disgrace a 3rd class ticca in British India, unkempt screws and bags of bones. Then I proceeded to Kioto, it was drizzling as usual. Kioto on a fine day is very enjoyable; there is a gaiety and life about the place, but save me from driving in a rickshaw over its villanously paved streets on a wretched spring day. Here I saw the famous cherry flower dance, the prettiest thing I saw in Japan and one worth going a long way to see. Temples, Diabatsus, shops and side trips and a week was pleasantly passed away; but be careful of side trips; take some smelling salts; the perfume from the fields in the Japanese country beats Cologne into fits. I have been in Cologne so I know. Another fraud is the trip down the famous rapids to Araysbima.

I had read about the thrilling sensation as you whirled down the *roaring torrent, momentarily expecting to be dashed to pieces;* so I went hoping for some good fun. Now it had rained steadily for a week so the rapids were at their best. I had eaten an excellent lunch, plenty of beer, and the excitement was so great I nearly went to sleep: but joking apart; what colossal liars write tourist books. I have had to go down the rapids of the Yu in Upper Burma on work and have kept my boots in my hands and my heart in my mouth as the Burmans strained through "Nga Mo," and it gave me a very tired feeling to see these trivial rapids classed as exciting. Old ladies might find it so, no one else could; as for danger, the hotel boots, a ripping sort, told me that he had never heard of an accident in the last 12 years. How very dangerous to shoot them! The tea house at the foot is very picturesque, with its flowering cherries backed by dark pines, and the gaily-dressed Japs strolling about in the grounds. From Kioto after visiting Nara, Nagoya, and other places, mainly temples, I went to Myanoshita. *En route* I got the only view of Fujiyama (except on every fan and lacquer box), that I got all the time I was in Japan; there were plenty of places one ought to have seen it from, and I daresay could, if it had not been for the mist and clouds. Myanoshita is a delightful place, with charming walks, to spend a week in; and the Fujia Hotel, one of the best I have ever struck, while the hot baths, water direct from the springs, are an endless joy. From thence I went to Nikko, the far-famed, the much-gassed about. It is certainly charming, given decent weather which I did not get. Murray raved about some water falls so I trudged off to look at them; it was as usual, a false alarm However, the beautiful groves of Cryptomerias would be worth going to Nikko alone to see, let alone the temples; and the collections of old relics in the temple grounds should on no account be missed. Tokio and Yokohama are uninteresting except, for the famous Yoshiwara. It's rather embarrassing to meet ladies from the hotel in which one is staying visiting these shrines, but now everyone goes to see them, so of course I also went.

The trip across from Yokohama to Vancouver is across the dreariest bit of water in all the seven seas; not a sail and hardly a living thing was seen for the twelve days, and a bitter wind blew direct from the Pole between the dull grey sea and leaden sky; so it was a treat to sail up the lovely inlet and through the Narrows into Vancouver's lovely harbour (another of the finest in the world). Vancouver is a most charming town, clean, go-a-head, magnificently situated and with a glorious natural park, though the beauty of this is much marred by the whitened skeletons of enormous trees, destroyed by the fires which once raged unchecked through this lovely belt of forest There is a first-class club in the town, of which I was fortunate enough to be made an honorary member, so

member, so had the chance of seeing some excellent stuffed heads of game peculiar to the North-West; in fact the most charming people in the world are the Canadians and they deserve to live in their beautiful country. To go and buck about Japan and its scenery while one has the chance of seeing the glorious scenery of Canada is imbecile; one, moreover, feels at home in Canada, the union flag on every building, the patriotic badges in every one's button hole, and to crown all the beautiful Canadian girls; and one really feels that if there is a paradise on earth one's struck it at last. I regret that having wasted so long in Japan my stay in Canada had to be cut short, so I boarded the C. P. R. train, trans-continental express, but decided to break the journey at Banff, situated in the Dominion National Park. Be sure and try and bag a lower sleeping berth as otherwise the discomforts of dressing are great, not to mention the want of ventilation: also take some Eucalyptus oil as the mosquitos on the Prairies are said to sometimes hold up the C. P. R. train. They did not quite do that to us but nearly; it licks anything I have seen in the east, the mosquitos beng about twice the size of the common or garden Burman variety, and in myriads. I'll not try to describe the Selkirks, the Rockies or the scenery, it would be absurd. Go and see it; besides I have not Murray's command of adjectives. The train got into Banff late in the evening, but "rigs," any horse vehicle is a "rig" in Canada much the same as it's a "machine" in Scotland, and a short drive takes you to the fine hotel built by the C. P. R. in the Reserve. I could have spent days there; the air is glorious and the food excellent. Rotten egg baths for those who fancy such luxuries, long walks, fishing, boating (even shooting I believe is to be had), soon make the time pass. I went off to see the Bisons (Buffalos) which are kept in a 1,000 acre paddock. They are doing excellently and look in magnificent health; they were just shedding their winter coat so looked a bit mangy, but very fat. From Banff one soon flies down the slope of the Rockies and gets on the Prairies. Just one word on Forestry, it shall be short—one is struck in coming through British Columbia, and also through Canada generally, at the reckless waste which is taking place with regard to the timber; enormous stretches of forest land are fired and of course the trees killed just to get rid of the timber; sometimes the train ran through miles of forest all standing gaunt and dead, the effects of fire. No country can stand that sort of thing long even such a moist land as British Columbia, but I suppose the colonists know their own business best. The only drawback to travelling in Canada and America generally is the nigger conductor of the trains, the side and impudence of the brute is intolerable. He thinks nothing of annexing a vacant seat in the saloon, sprawling all over another, picking up your magazine without a "by your leave" and going to sleep with it most likely as a pillow. I only met with kindness, courtesy and civility from

every white throughout Canada, the nigger only was too big a swell for his work; the man on one car might have been the President of the line, except that it's a hundred to one the President is a gentleman. Don't buy meal tickets before starting; just pay for your meals as you go and don't tip the waiters, it's useless; you have to tip the black individual *mentioned above, worse luck*. Going across the prairie is very much like being at sea again. I was lucky enough to see the small prairie dogs, Buck, and a coyote from the train. We came through the last of the Rockies as the news that Mafeking had been relieved came through. Every engine we passed whistled for all it was worth, ringing its huge bell, and burst out with flags. I saw one with no less than eight Union Jacks decorating it, let alone an old Royal Ensign or two We were late into Winipeg so I lost a chance of seeing a typical Western town. The Railway Station, however, was enough, it scared me; one did not know quite whether it was *High* street, *Winipeg*, or *the* Central Depôt; it seemed, however, the favourite resort of cyclists, the feminine portion of which chose the centre of the track for choice. The pace the cable cars travel at too, shade of a County Councillor and a London Bobby! So on to Toronto. We arrived on the date of the races and as the Governor-General was there the combination just filled the town; it's a delightful place and I saw too little of it as I had lots to do, so went on next day by steamer to Niagara. Be sure to go by the Electric train along the Canadian side of the gorge, the views are much finer. From Niagara *via* Buffalo, catching the Empire State Express I was whirled into New York. What strikes one there is the expense of everything, the good hotels, and the fine feeding; there is no doubt the Yank knows what's good to eat, one gets better food than in London and there is no comparison between the hotels. However, there is a bit too much rush and tear about New York, one thing that was pleasant was the absence of any early-closing Act. New York never seems to go to sleep; it was pleasant to go off to supper after a Theatre and not be worried with "Now, then, gentlemen," just as one had reached the *entré*. One Saturday night, or rather Sunday morning, I was in a saloon and called for a drink; the waiter placed a mouldy piece of German sausage on the table with my drink. On my remonstrating that I had not ordered the fossil in question, he said "it's all right, Sir, no charge for it. We are not allowed to serve drink, unless we serve food too on Sunday." Thus is the Law made naught of and the *unco guid* put to rout. I enjoyed my stay in New York as well as a trip I made through the Eastern State immensely, and it was with regret that I boarded the magnificent Cunarder to start for England. We had a splendid voyage across, and the Cunard line is not overrated; *everything about it is tip top, from the courteous* stewards to the excellent grub. What's more, it's the first steamer I have ever been on that had an adequate smoking room.

In conclusion I should advise men wanting a change to come home the way I did; but avoid boats not flying the old flag and do not miss the journey by the Canadian Pacific Railway. As for expenses 4,000 dibs will see one handsomely to London, ticket, living, larks and all.

TAW KWE.

VI.—EXTRACTS, NOTES AND QUERIES.

The Forestry Schools of Europe through American spectacles.

America is a marvellous place in many ways, notably in the matter of accuracy. The accuracy of its machinery is proverbial. So is that of its descriptions and stories. "*American Gardening*" is a go-ahead paper, and no doubt knows a lot about gardening, especially in America. It has been allowing a well-meaning person, called S. W. Fletcher, to instruct the Great American People on the subject of Old World Forestry. This is to be regretted, for, however good the intention, it cannot be denied that S. W. Fletcher's knowledge has failed to guide his imagination along the straight road of facts. So long as S. W. Fletcher confines his remarks to Germany, his information appears to be fairly correct, and sometimes amusing, as for instance when he draws a picture of the German student writing out a petition for access to a book in the library, and waiting 48 hours for an answer. One wonders where the librarian was, and why he did not make the student sign an indemnity bond before three reliable witnesess, and then go and insure his life, assigning the policy to the University. This procedure, however, might have taken more than 48 hours.

S. W. Fletcher then passes on to "the progressive Danes," and deserves to be quoted in extenso. "*Denmark is the most progressive of European countries in Forestry education. Even the Germans, the fathers of Forestry, are now introducing Danish methods. The superiority of Danish forestry is largely because it has been under private instead of Government control.*" This is precisely the case with English forestry, which is certainly not of a "superior" order. On the other hand, in the States, whose Government is certainly not of a "superior order" either, (being the exclusive appanage of carpet-baggers and log-rollers) there is no such thing as private forestry; for Vanderbilt is a "king," and the rest of the forests belong to States or Universities. Lord Lawrence's reply to a certain Punjab Bank that had asked for a big forest concession was very sound:—

"*Private enterprise, I know, public loot.*" The United States have as yet hardly reached a stage of mental development at which they can appreciate the attitude of Lawrence, but it is coming, thanks to the ferment set a-working by the Division of Forestry. "*In Germany, the forest is the unit; all the trees in it receive practically the same treatment. In Denmark the tree is the unit; special treatment is given to each.*" Now, an acre may contain say, between 8 and 8000 trees, and a year contains 365 days. It is easy for the illiterate to form some idea of the amount of special individual attention that each tree can receive, and of the alarming self-sacrifice exhibited by the Forest Officers. Luckily Denmark is a very small country and the whole of it is not forest. *The interest on capital invested in German forests is 8 per cent; in Danish forests, 10 per cent. It pays to specialise.*" If this statement is true as a general proposition (and I am far from hastily accepting it as gospel), I can only say I am sorry for Denmark.

S. W. Fletcher next informs the Great American public of the condition of France. "*France has but one Forestry School, and this is but a Department of the Military School at Nantes.*" Military men may know something of a military school at Nantes. Probably there is at least a military riding school there, but in any case it has nothing to do with forestry. France has two schools of Forestry, one at Nancy, and one at Barres, and I am sure, after his remarks on Denmark, it would do Mr. Fletcher good to go to either of them. "*Except for a little woodland near Paris, France is practically denuded of forests.*" The exhibition, or as Mr. Fletcher would doubtless prefer to call it, the Exposition, accounts for much, but I shall take the liberty of making further inquiry before crediting it with the destruction of forests that last year covered about 7½ million acres, exclusive of extensive private woods.

"*Belgium has no School of Forestry.*" It appears rude to contradict a man so often, but Belgium certainly has, or had a few years ago, an excellent School of Forestry. "*Russia, Norway and Sweden, and Finland have one each, and are beginning to take effective measures for conserving the remnants of their woodlands.*" These countries have had a Forest Department for a century, but without control over private forests, and it cannot be denied that the felling has been excessive. "*The forests of Austria have had little care; even the famous Bohemian forests have been under forestry management only about 20 years.*" Much depends on what is understood by forestry management. There was once a person called Maria Theresa, who in her days caused an immense amount of excitement in Europe. She reigned over these parts for many years, but her fame may not have been sufficiently great to have penetrated to Mr. Fletcher in the States. Among other exploits of merit, she ordained

the teaching of Forestry in Hungary at the Selmeczbanya School of Mines, and probably in the other parts of her dominions, but I have not the necessary references at hand. I can, however, state from personal knowledge that "20 years ago" even half-fledged little States like Servia and Montenegro, were taking steps towards the preservation of their forests.

As a final *bonne bouche* "*Great Britain has one School of Forestry in India (with a preliminary training branch at Staines, a few miles west of London, Ed. Amer. Gard).*" Sad it is to see the Great American public so misled. Mr. Fletcher may be interested to know that he might find five places where forestry is taught, one in England, one in Scotland, two in India and one in Burma, and that these five places are connected by exactly the same bonds as those binding the proverbial chalk and cheese.

F. GLEADOW.

We reproduce below from "*American Gardening*" the article reviewed by Mr. Gleadow.

The Forestry Schools of Europe.

Mention has been made in the *American Gardening* of the New York State College of Forestry, established at Cornell University in September 1898. This is the pioneer forestry school in the United States, and owes its existence to the bounty of the States of New York. A college forest of 30,000 acres, one-half of which is virgin timberland, has been bought near Tupper Lake, in the Adirondacks. It will serve not only "as a demonstration and experiment in sylvicultural methods and as a practice ground for the students, but to develop such methods of management, as will make the forest self-supporting and, if possible, earn a revenue." During the spring and summer months the junior and senior classes rough it in the forest. The out-look of this new college is promising. No one who has witnessed the injudicious treatment of the American timberlands will dispute the wisdom of maintaining this training school in economical forest management.

The Fathers of Forestry.—Dr. John Gifford, the recently appointed professor of forestry, received his professional education in the forestry schools of Europe. In a talk before the Lazy Club, Professor Gifford credited Germany with the greatest development in practical and theoretical forestry. The forestry schools of Germany are of two grades:—First, the *academise*, graduates of which become candidates for the position of assistant forester, a sort of apprentice to the head forester; second, graduates of which become head foresters and teachers.

There are six forestry academies and three schools of forestry in Germany. The best of the latter is at the university of Munich. Curiously enough, it is called the Department of Economics instead of forestry, and graduates receive the degree of Doctor of Economics, although there are eight professors of

forestry and one of Economics in the department. Political economy is the only required subject in the course; all the remaining fifteen are elective. Equally curious and illustrative of the Teutonic temperament, is the amount of red tape which a student must unwind before he can consult the Forester's Library. One would naturally think that a library should exist, primarily, for the use of the students, and that the university should give them free access to its shelves. Forestry students at Munich must give forty-eight hours' notice before they may consult a book, and even then a professor must go with them to the stocks. More than likely the learned professor is busy and cannot go. Dr. Gifford was at Munich eight months and was not able to get into the Forester's Library in that time. Notwithstanding these eccentricities in German education the instruction at Munich is excellent. The forestry school at the university of Halle is also good.

Forestry in Germany is largely under Government control. The Government owns many of the forests and derives revenue from their management. Many of their forest rotations have been running 250 years. In one sense, German forestry dates back to the middle ages, when forests were protected and the peasants allowed certain rights in gathering wood.

The Progressive Danes—The Danish school of forestry is at the university of Copenhagen. Denmark is the most progressive of European countries in forestry education. Even the Germans, the fathers of forestry, are now introducing Danish methods. The superiority of Danish forestry is largely because it has been under private instead of Government control. This has resulted in a constant search for, and introduction of better methods; while the more conservative Germans are loath to disturb their forest rotations which have been running for centuries. In Germany the forest is the unit; all the trees in it receive practically the same treatment. In Denmark the tree is the unit; special treatment is given to each. The interest on capital invested in German forests is three per cent., in Danish forests ten per cent. It pays to specialise.

The French School—France has but one forestry school and this is but a department of the military school at Nantes. All French foresters are primarily military men. Except for a little woodland near Paris, France is practically denuded of forests.

Wasteland in Holland.—Holland has no school of forestry but has 900,000 acres of wasteland which ought to be covered with forests. We usually think of Holland as a garden spot, with every foot of land under extensive culture; but fully one-half of the country is a waste, quite similar to our southern pine-barren lands. It is lands which have been deprived of all fertility, or the power to produce crops, by the same stamp of ignorance and greed which is now robbing some of our best American soils. It is a rich soil and was covered with a thick growth of oak. Now it will not even grow Scotch pine—the surface soil

has been dug off for composts and sheep have grazed it from time immemorial. Although the Government has a Department of forestry, practically no attempts have been made to reclaim this waste, except by private experimenters. It seems rather remarkable that out of hundreds of trees tested, one man has found *Prunus serotina*, our wild black cherry, and the Douglas spruce best adapted for covering those barren acres.

What we owe to the Monks.—Belgium has no school of forestry, although it has some very poor land which ought to be re-forested. Russia, Norway and Sweden, and Finland have one each and are beginning to take efficient measures for conserving the remnants of their woodlands. The forests of Austria have had little care; even the famous Bohemian forests have been under forestry management for about twenty years. Great Britain has one school of forestry in India [with a preliminary training branch at Staines, a few miles west of London. ED.] which is well attended; there is but little opportunity for a forester in the British Isles. Italy has the "Royal Italian Forestry Institute" near Florence, and the beautiful forest of silver firs in connection with this school is the only respectable woodland in all Italy. As with most of the older forestry institutions of Europe, the school was formerly an abbey and the forest was planted by monks.

Trying to check the avalanche.—The forestry of Switzerland is of special interest because this is the land of the peasant and all forest improvement has been made with great difficulty. The forestry school recently started at Zurich, but distinct from the university of Zurich, is one of the best in Europe; although it is a decided disadvantage to have most of the professors lecture in very bad French or very bad German. This school has a good forest at its disposal, but does most of its work in out-of-the-way places, for the main object of Swiss forestry is to prevent avalanches on the mountain sides. Forests have been started for this purpose in many places at so high an altitude that a masonry wall is built to protect the slow-growing trees until they are large enough to withstand the snow slide. Swiss forestry has often met with strenuous opposition from some-short sighted peasants who wish to pasture their goats on the mountains.

How the destruction of forests increases danger from floods.—It is still an open question whether the deforestation of Europe has had any direct effect on the amount of rainfall, but it has certainly increased the danger from freshets. If rain falls in a forest area it is held as in a sponge by the large amount of humus under the trees and is given off gradually in times of drought; while a heavy rain falling on bare land immediately runs off as surface water to swell the flood. We should have forests on all the important watersheds of the country, as the Adirondacks and some of the western reserves. The State of New

York and the United States' Government have acted wisely in providing for the conservation of these forests.

The sanitary value of trees for drying wet land has not received the attention it deserves. The eucalyptus is fast draining the malarial swamp around Havana and has been used successfully in California for the same purpose. [*Also in Italy.* ED]. It can suck up more water than most trees and will grow 75 feet in seven years, notwithstanding its wet feet. There is need of further experiments on the sanitary value of trees.—*S. W. Fletcher, in American Gardening*

Wood-pulp for Paper.

It is suggested that India might derive some advantage by the present paper famine by allowing her forests, or at any rate her fibre resources, to be utilised for the purpose of paper manufacture. † So great is the scarcity of paper that the prices paid by newspapers have risen during the last six months or so by 60 to 80 per cent; certain fortunate newspapers, however, are being supplied under long forward contracts and it is said that the suppliers in these cases are losing heavily. Less-favoured newspapers, which have to pay market-rates are curtailing their output and urging agents not to order more copies than they can actually dispose of.

The causes of this paper-famine are numerous. The prices of chemicals, which play an important part in the manufacture of paper, have been very high for some time; while the prices of coal, which is likewise important in paper making, have risen considerably. Two tons of coal are required to make a ton of ordinary newspaper; and four tons of coal for one ton of good quality paper. Moreover, wood-pulp, which enters largely into the composition of the cheaper papers, has become scarce. The chief sources of supply were Canada and Sweden. The Swedish supply fell last year, owing mainly to a drought which affected the water-power chiefly used in the preparation of pulp. And now the Canadian supply is almost suspended—temporarily at any rate. It is computed that the English and French factories alone use about two million trees per annum and it is evident that fresh sources of supply will have to be found, if a prolonged paper-famine is to be avoided. Under these circumstances some are of opinion that the Indian forests might be exploited, but others are much opposed to this proposal, and urge that India requires all her forest supplies for fuel, &c., to say nothing of resources. The fibre resources of India might, however, be utilised, and some suggest that grasses resembling the Esparto grass of North Africa would be found useful.—(*Capital.*)

† An article drawing attention to this subject, with special reference to the utilization of the Himalayan Spruce for the production of wood pulp will appear in the next number of the *Indian Forester*. Vide also, *Indian Forester*, Vol. XXV, No, 6, page 231.—HON. ED.

THE

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The Indian Species of Dillenia.

Every Forester in India knows what a *Dillenia* is. The large leaves with numerous prominent secondary nerves, the large showy flowers and the curiously mottled wood, with its broad medullary rays, these characters distinguish them from all other trees. The number of species is not large and most of them are easily known. *Dillenia indica*, the *Thabyu* of Burma, an evergreen, with large white flowers and huge fruit, once seen, is never forgotten; *D pentagyna*, *Zinbyun*, Burm., with comparatively small, fasciculate, yellow flowers is a well known companion of the sâl tree in the sub-Himalayan tract and common in deciduous forests of both peninsulas. During the rains of 1856, after having spent 5 months in the Teak forests of the Pegu Yoma, I went up by steamer from Rangoon to Prome, and in the Panlang Creek the Captain held forth to the admiring Griffins on board: "Here, gentlemen, you see the Teak forests of Pegu." The better-informed knew it was *Zinbyun*, common on low ground in that part of Burma, and commonly called Bastard Teak.

One or two Burmese species, however, deciduous trees with large yellow flowers, have not yet been sufficiently studied, and the chief object of my present communication is to induce Foresters in Burma to study them and to favor me with the result of their observations, so that I may be able to set forth in "Indian Trees" the distinguishing characters of all Dillenias correctly. The following brief synopsis of the Indian species, with the more important synonyms, references, and vernacular names may perhaps be acceptable to foresters in other provinces also. Corrections and additions will be thankfully received Good flowering specimens of *D. bracteata*, *scabrella*, *parviflora* and *pulcherrima* would be very acceptable.

A. EVERGREEN, FLOWERS WHITE.

1. *D. indica*, Linn. Syn.—*D. speciosa*, Thunb; Wight Ic. t. 823; Bedd. Fl. Sylv. t. 103. Vern. *Chalta*, Beng.; *Motha Karmal*, Mar.; *Thabyu*, Burm.

Leaves coriaceous, lanceolate, slightly pubescent beneath, blade 10-15, petiole 1-2 inch long, secondary nerves 30-50 pair. Styles 20. Fruit 3—5 in. diameter, hard outside. Sub-Himalayan tract, from Nepal eastward. Moister regions of both peninsulas, chiefly along streams. Fl. R. S.

2. *D. bracteata*, Wight. Ic. t. 358.

Branchlets, petioles and young leaves grey-silky, leaves coriaceous, broadly elliptic, obtuse or emarginate, blade 3-5, petiole ½ inch long, second nerves 12-20 pair. Fl. in few-flowered racemes, 2-3 inch diameter, sepals silky, carpels 5.

Kambakum hill, Madras; Veligondas and other hills of the Karnatic.

B.—DECIDUOUS, FL. YELLOW, FASCICLED, APPEARING BEFORE OR WITH THE LEAVES.

3. *D. pentagyna*, Roxb. Cor. pl. t. 20; Bedd. Fl. Sylv. t. 104. Vern. *Aggai*, Oudh; *Karmal*, Mar.; *Kanagola*, Kan.; *Zinbyun*, Burm.

Leaves silky, pubescent when young, nearly glabrous and shining when full-grown, 12-36 in., narrowed into a short winged sheathing petiole, secondary nerves 30-40 pair, often with branches near the edge, these as well as the nerves excurrent into fine silky teeth. Fl. barely 1 inch diameter in fascicles of 5-10, or tuberosities along 2-3 year old branchlets, which are marked by the scars of the sheathing petiole, pedicels slender, 1-3 inch long. Carpels 5, fruit ¾ inch diameter, enclosed by the fleshy sepals.

Sal forests of the Sub-Himalayan tract, from Oudh eastward. Deciduous forests in both peninsulas. Sheds its leaves in the H. S., comes into flower soon afterwards.

4. *D. scabrella*, Roxb.; Wall. Pl. As. Rar. t. 22.

Young shoots grey-silky, leaves membranous, upper side rough, underside harshly tomentose, oblanceolate, gradually narrowed into a short narrowly winged petiole, blade 9-12 in. long, secondary nerves 35-45 pair, fl. 1½ inch diameter in fascicles of 3-7 on slender glabrous bracteolate pedicels 1½ in. long, sepals glabrous, carpels 5-7. Fruit fleshy, orange-coloured, ¾ inch diameter.

Assam, Khasi Hills, Chittagong, Andamans, Zamayi forests, Pegu.

5. *D. passiflora*, Griff.; Kurz F. Fl. I. 21. Vern. *Lingyaw*, Burm. All parts pubescent, leaves coriaceous, rusty-tomentose beneath. Fl. 1½ in diameter in fascicles of 2-4 on pubescent naked pedicels 1-2 inch long. Sepals densely pubescent, petals on long slender claws, carpels 5-7, fruit 1-1¼ inch diameter, pubescent.

Lower Burma, H. H. S.

C.—DECIDUOUS, FL. YELLOW, SOLITARY, APPEARING BEFORE OR WITH THE LEAVES.

6. *D. aurea*, Sm. Syn. *D. ornata*, Wall. Pl. As. Rar. t. 23. Vern. *Aggai*, Oudh ; *Kallei*, Gond, Banjar valley, Central Provinces; *Byu*, Burm. Youngest shoot pubescent, leaves glabrous, coriaceous, obovate, narrowed into a stout, channelled and sheathing petiole, blade 6-18, petiole 1½-2 inch long, secondary nerves, 30-40 pair. Fl. 2-3 inch diameter, pedicel 1-1½ inch long, carpels 8-10. Fruit fleshy, yellow, 1½-2 in. diameter.

Sâl forests of Oudh and the Central Provinces ; Burma, hill forests, ascending to 4,000 ft. Fl. H. S.

In this section Kurz places *D. pilosa*, Roxb. and *D. pulcherrima*, Kurz. To the last I would specially draw attention. According to Kurz it grows in the Eng and Savannah forests of Pegu and like *D. aurea* flowers in the H. S. Its distinguishing characters are said to be :—Leaves coriaceous, slightly pubescent when young, soon turning quite glabrous and glossy, usually rounded at base, coarsely repand-dentate, petiole 1 inch. Fl. 4 in. diameter or larger pedicel pubescent, 1½-2 inch long, sepals ciliate, adpressed, silky, carpels 12, fruit orange-yellow 1½ inch diameter. A specimen collected by Mr. Smales in Daungyu, Upper Burma, in April 1899 (*Zinbyun gale*, Burm.), fl. 3 inch diameter, otherwise nearly corresponds to Kurz's description. *D. pilosa*, Roxb. is in Fl. Brit. Ind. I, 38 classed as a synonym of *D. pentagyna*. Kurz ascribes to it solitary fl. 2½ inch diameter. It is a doubtful species.

Bonn, July 1900. D. BRANDIS.

The Cultivation of Para Rubber.

(*Hevea Braziliensis.*)

The Government of India having recently sanctioned the formation in southern Burma of a plantation of 10,000 acres of this valuable rubber-producing tree, it may be of interest to record some observations made in the Straits' Settlements, and in the Federated States of the Malay Peninsula, where its cultivation has, for the past three years, engaged the attention of coffee planters and others.

There was a time when the price of coffee was such that it meant a rapid way to fortune to any one who could plant it, even in Malaya, with its scanty labour-supply and vast resources in tin which constantly serve to divert what labour there is from less remunerative agricultural work. The price of coffee, now at 23, rose as high as 40 (two shillings) dollars a picul of 133·3 lbs. and attracted planters from Colombo to the virgin soils of the peninsula. Besides those skilled in planting, all sorts and conditions of men rushed in with their monies and invested them in

coffee plantations. Highlands with slopes from which the vegetable mould was quickly washed were cleared and planted equally with the rich peaty lowland soils adjacent to the mangrove swamps: and then the price fell to 19, and even touched 15 dollars a picul. Not only were estates unable to show any profit, but most of them could no longer pay working expenses, and the dread of throwing good money after bad soon led to their abandonment.

The proprietors of those estates, which were able to keep going and wait for better times, were prompt to look round for some paying crop to eke out the return from coffee. Fortunately for them the Para tree had been introduced by Sir Hugh Low in 1877, and three years ago, these trees of 20 years, as well as others of 10 and 18 years in Singapore, Penang, and parts of Perak were living examples of how the tree grew under all sorts of conditions, and prospered on river banks, subject to occasional flooding, as well as on hilly well-drained sandy soils.

It was seen to attain in 10 to 12 years a height of more than 70 feet with a girth at breast height of 4 feet and more. Trees in places were forming a complete canopy, and the yield of a given area could easily have been ascertained. Instead of this, experiments were made with individual trees, and Mr. Curtis, Asst. Supdt., Botanical Gardens, Penang, obtained over a period of 14 months, from a tree 18 years old, in 3 tappings, each extending over a month, with 5½ months intervals, no less than 8½lbs of dry rubber. The cuts were renewed every other morning during the tapping time. From a number of trees 6 years old at Kuala Kangsar, tapped during the months August to October 1898, Mr. Derry obtained on an average 10 ounces of dry rubber. The value is stated to be 3s. 6d. to 3s. 8d. per pound. It was concluded that trees 12-13 years old would yield on an average 5lbs. of rubber a year. Here then was a shade tree with which to overplant the coffee, and a gold mine besides, if all went well. It is small wonder that within the last three years thousands of acres in Province Wellesley, in Perak, but more especially in Selangor, have been planted with Para, 12 ft., 15 ft., 20 ft., and even 30 ft. apart over coffee. In some places it has been planted in belts with the object of shading the coffee intervening and not causing injury by its roots. The growth is marvellous, as much as 10 feet in a year, and it sends up three successive annual shoots without throwing out any branches. It grows readily in nurseries, sown quite shallow and then covered with grass, to aid in retaining the moisture in the beds. At the time of transplanting, plants 3 ft., 4 ft., and even 6 ft. high are taken and cut back to within six inches from the ground from which they send up a vigorous coppice shoot. In these equatorial climes they flourish quite in the open and show no sign of being delicate or requiring a shelter-wood such as Mr. Manson proposes to give them in Burma. The use of the virgin forest to draw the tree

up clear of stem is hardly to be explained when in 3 years they will attain in the open, 30 feet without a branch. Is it not to be feared that planted in forest they will suffer from the cover and fail to make growth in the spaces provided for them? Experience will teach, but it might be well to try clearing and burning the entire forest, and then planting 12 by 12, in order that a complete canopy may be formed in 10 years. There would be no weeding after the first rains, for the plants would shoot ahead like the most vigorous young teak of the plantation does, and nothing but bamboos would be likely to overtake them; and all undergrowth should be preserved. The success of such planting is in evidence both in Perak and in Singapore, and an ounce of practice goes far to counterbalance a mountain of theory however much studied.

TAU-THA-MA.

Notes on Dendrocalamus Strictus.

In the *Indian Forester* for January 1900, Mr Fisher calls attention to the treatment of bamboos. This is an interesting question; it has formed the subject of a good deal of correspondence, and I will endeavour to lay down my experiences in connection with the above species.

To do so, it is necessary for me to give a history of the past working of the male bamboo (D strictus) in the Ganges Division of the Central Circle, N.-W P. and Oudh, (where I have more particularly studied the general question of the trade and growth of the bamboo for the last three seasons), so that the reader may know the conditions under which the little knowledge I possess has been gained.

The forests lie at the foot of the Himalayas bounded by the river Ganges on the west, and by the Ramganga on the east. These forests have, for many years, supplied Meerut, Delhi, Anupshahr, Chandausi, Cawnpore, Bareilly, and even some of the large towns in the Punjab with bamboos.

The following shows the average annual export for the quinquennial periods since 1880 :—

1880-85	...	9,000,000	bamboos.
1886-90	...	12,000,000	,,
1890-95	...	9,800,000	,,
1896-1900	..	8,100,000	,,

Formerly the civil authorities had the management of these forests. They were leased out to farmers who collected an export fee on the bamboos, as they went past their "chaukis" on their way to the plains.

In 1868 the forests came under the control of the Forest Department. The same system of export was continued, but the "chaukis," or revenue collecting stations, were managed by Government agency. During this period the bamboo cutters were under no restrictions, and the forests do not seem to have been given any regular periods of rest.

After a visit by the Inspector-General of Forests in 1883, an order was issued obliging contractors to leave not less than 4 growing culms in each bamboo clump; and at the same time a new schedule of royalty rates was drawn up with a view of checking the export of the thinner bamboos. The results were satisfactory, if such can be judged from the increased outturn and revenue that subsequently followed.

In 1885-86 we find that the above restrictions were not considered sufficient, and at the end of the decade several schemes were introduced closing the bamboo areas periodically to cutting: but it was not until 1890-91 that all the forests in the Division were embodied under one scheme. This scheme has been included in the present working plan and provides for the cutting of the different blocks every alternate year. It also lays down—(a) that none of the last rain's shoots shall be cut, and (b) that the culms are to be cut as near the ground as possible.

We have seen that at first the revenue was collected at fixed rates as the bamboos passed the revenue collecting "chaukis," situated on the outer boundaries of the Reserved Forests. This, however, naturally caused the nearer or outer blocks to be far more cut over than those further inside. To equalise matters the blocks, (some time in the eighties), were sold on monopoly by auction; *that is to say*, the blocks were put up to auction, the contractor bidding a sum for the sole cutting right in the area sold, in addition to paying the fixed royalty at the revenue-collecting chaukis.

This system lasted until 1896-97 when a round-sum system of auction sales was introduced, the contractor buying a block for a round sum and taking out what he could in the time allotted in his lease.

It will therefore be gathered that the forests of this Division have been under different kinds of systematic management for a number of years, quite long enough to form the present bamboo clumps on which my experience has principally been gained.

General Rule regarding the growth of a D. Strictus clump.

After a seedling has established itself, growth takes place from the centre; the rhizomes radiate from that centre forming thicker and better culms as the plant as a whole gathers strength. As age advances a tendency may be noticed for the clump to advance in certain directions only; or in other words, that the

rhizomes are more vigorous in certain parts of the periphery of a clump than in others. This gives the clump, as I said, a tendency to advance in certain directions: if on a slope, the tendency is to advance up that slope; if on the flat, the tendency is controlled by obstructions, such as—(1) the cutting of all the bamboos on one side of the clump, thereby killing the rhizomes below, and thus causing, for the time being, a more or less impenetrable barrier to the growing rhizomes; or (2) rocks; (3) quality of soil, etc.

It is to this tendency to advance in a particular direction that I particularly wish to draw attention; because on it the system of management should be based; for it is evident that if a clump can be encouraged to advance in particular directions and to gradually occupy new soil, less care and money need be spent on clearing out the existing clump. I will further enlarge on this subject under the following heading, namely:—

The effect of cutting on a growing bamboo clump.

When a cutting takes place it may be heavy or light. If light, it generally means that only a few of the better culms are removed and the effect on the root-system is not one that will cause any serious disturbance.

When the cutting, however, is heavy, the root system is seriously disturbed. Take a plan of the root system of a clump, Fig. I, with the youngest culms at A, A', and A." A heavy cutting, taking two cases only, may leave the clump as in Fig. II or III.

Fig. I.

```
          A
          o
         o o
       o o o o
        o o o
       o o o o        31 culms.
     o o o o o o
     o o   o o o
    o o      o o
             o
             o
    A          A''
```

In Fig. II the outside bamboos have been cut, leaving 14 culms bunched together in the centre.

In Fig. III a thinning has occurred, leaving 10 culms scattered more or less uniformly over the area occupied by the clump before it was touched.

The asterisks show wherever the bamboos have been cut.

Fig. II.

```
          A
          *
         * *
       * * o o
         o o o
       o o o o     14 culms.
    * * o o o *
    * *   o o *
    * *     * *
            *
 A'         *
               A'
```

Fig. III.

```
          A
          o
         o *
      * * * *
       * o *
      * o - *        10 culms.
   * o * o * o
   *   *   * * *
 o o       o *
 A'          *
             *
              A''
```

Now let us consider the results of these forms of cutting on the root-system, or, in other words, on the vitality of the clump.

It will be found that when all the culms are cut over a large part of a bamboo clump that the root-system underneath dies and forms a more or less impenetrable mass of dead stuff that will afterwards prevent the rhizomes from spreading in that direction. This is the rule, but it may be noticed that thin whips of culms are sometimes thrown out in the next year from this cut over root-system, which whips are of little value either in the market or to the clump itself.

In Fig. II we see that the root-system will die practically all round the remaining culms, and that the young rhizomes produced from the live system in the centre will be forced upwards among the standing culms and cause congestion, and for want of sufficient soil will probably be small.

In Fig. III it is probable, unless the thinning is scientifically executed and unless the culms are left very close, that pieces of rhizomes will die over the whole space occupied, but that the live rhizomes under the standing culms will be more scattered than if cut as in Fig. II Eyes may thus produce new shoots over the whole area, but these will have difficulty in spreading, except on the periphery.

In Figs. I, II, and III, I have shown where the youngest culms are growing, *viz.*, at A, A', and A.'' I have noticed that the rule of growth is for the stoutest and therefore best culms to spring from near those places on the periphery of a clump where the youngest culms are. In Fig. II all these young culms have been removed, so the chances are that the new culms afterwards formed will be small. In Fig. III we have young culms left at A, and A,' and the chances are that good culms will grow near these places, but that inside they will be smaller during the first few years, and until those rhizomes which have been killed have rotted away. By that time probably the clump will have been filled up with small culms, unless kept open.

From the above, therefore, it will be gathered : —

(1). That a bamboo clump should be encouraged to advance in the directions chosen by itself, which can be told by observing where the youngest culms are.

(2). That bamboos should not be cut over the whole periphery of a clump.

(3). That care should be taken not to clean out too large areas in a clump, if the object be to keep the whole root-system alive.

Treatment of congested bamboo clumps.

In every bamboo forest one meets with old congested bamboo clumps, generally situated on open grass lands and on the flats at the outskirts of the reserves facing the plains. They contain a dense mass of bamboos of all shapes growing as close together

as they possibly can. Uncontrolled bamboo cutters either take the bamboos on the periphery or cut the tops off those that *they can get at, often climbing 10ft. or so to get at them.*

It is difficult in all cases to tell why clumps have become congested, but I am of opinion that the following are generally the causes.

(1) Unrestricted cutting by man, when the bamboos on the periphery only are cut, thereby forcing the growing culms to turn backwards, by the dying off of the outer rim of the root-system.

(2) The grazing of the young shoots by cattle.

(3) The continual removal of young shoots for cooking purposes.

(4) Soil, hard and poor.

All these have the tendency to prevent the natural advance of the clump.

In the Saharanpore Division a system of thinnings throughout the clumps has been introduced by Mr. Gamble and carried on by Mr. Oliver. As carried out there, under careful and experienced supervision, and also over very small areas, the system has been a success. In dealing with large areas, however, the general supervision, that in an ordinary Forest Division is possible, *is not sufficient, and the introduction of a* thinning system would probably result in the clumps themselves being destroyed.

For, unless the culms to be left are marked by an experienced officer, I do not see how it would be possible to instill into the brains of each individual coolie of a large gang either the object of the cutting or the method.

In forests on the slopes and amongst tree-growth where the soil is loose, (and in less favourable places where the clumps have been regularly cut over), I have noticed that the cutting of all the bamboos on one corner, say, of a clump has caused the clump to throw out another protuberance of young culms, as shown in the following figures.

Fig. IV.

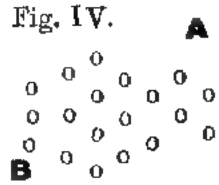
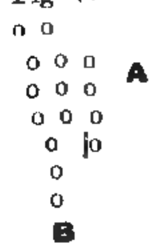


Fig V.



A is the corner of the clump where the youngest culms are situated.

In Fig. IV we see a clump naturally extending in the direction of A.

It happened that all the bamboos were cut in one year at A, the rhizomes there dying caused the clump to extend in another direction B, as in Fig. V

This is common in the smaller clumps of these forests; when it happens that no fresh culms growing in one eyear, as at A,

all the standing culms are removed the next (from the same spot A). *But the clump still having some vitality throws out* some new shoots on some other part of the periphery as at B, and extends in that direction.

It therefore seems to me that in dealing with congested clumps we should :—

(1) Stop grazing, if possible, or reduce the number of cattle, and prevent the access of man to the clumps during the rains when the young shoots are forming;

(2) Spare the places on the periphery where most young culms are present ; and

(3) Cut into the congested clump by means of channels 1' 6" to 2' wide ; and hoe up the ground on the outside to encourage the extension of the clump away from its present position, thereby helping to form 2 to 4 clumps in the place of one.

Before resorting to anything I should advise the strict closure of the forest to be treated for 1 or 2 years in order to ascertain where the young shoots are present in the greatest numbers, and during this time it would do no harm to hoe just round the periphery and remove any dead tissue or rock met with.

The cutting in (3) could be done by purchasers, and would require less supervision than a thinning.

Density of Cutting.

As I have before remarked the only restrictions imposed on cutting contractors in this Division is that they must not cut last rains' shoots, and that they must cut as near the ground as possible ; the areas also are only worked over every alternate year.

So far as my experience goes it is not necessary to have a large clump for the production of the largest culms ; each clump appears to be able to throw out culms up to a certain size only.

The largest bamboos in this Division are found in a few well-known blocks, and an examination of these blocks shows that the clumps are *really* no bigger than *those producing* thinner bamboos elsewhere. The reason for the superior size is fully explained by moisture and better soil.

For the continuance of the production of the stoutest bamboos that a clump can form, it is necessary to have a certain number of older culms present, to supply the leaf surface required, and this number seems to vary with the soil and aspect.

In the larger area of the bamboo forests in this Division we have two principal conditions of growth :—

(1) In the valleys and on the lower slopes of the hills.

(2) On the dry slopes and ridges and uplands.

On the first we find long and stout bamboos, hollow nearly down to the ground. On the second we find shorter, and perhaps not so stout, but more solid bamboos.

In cutting over both these situations it is necessary to adopt the same rules, for it is difficult to separately demarcate them on the ground.

I am of opinion that the present rules prevailing here do not allow for a sufficiently large clump being left; and when I say this I am not referring to the large congested clumps one finds on the flats outside the hills, but to the smaller clumps met with over the greater bamboo-producing area of this Division, say, to clumps of from 10—25 culms or less.

Young culms are not necessarily formed every year. Last year, for instance, was a bad year for growth; and I noticed many clumps that had produced no new culms, and many more that had grown very poor and thin ones. The result of this was that the clumps cut over last season had few last rains' shoots left in them to continue the vigorous growth of the clump. I would therefore suggest for this Division that the old rule by which contractors were required to leave a few first-class quality old culms should be reintroduced

The following conditions should therefore be included in any rules drawn up for controlling the cutting of bamboos over large areas, which it is not possible to minutely control.

(1) The preservation of last rains' shoots to ensure the vitality of the rhizome system at its most vigorous part.

(2) The retention of at least 2 -4 first-class culms, to ensure the general vitality of the clump.

I cannot close under this head without adding my impression that in the past the experiments carried out have been on congested clumps; when the proportion of such in a large continuously-worked area like the bamboo area of this Division, to the smaller ones is a comparatively low figure. Further, it is more profitable to have a number of closely-growing small bamboo clumps than a few large ones on the same sized area.

Is a period of rest required?

Generally speaking, this question must be answered in the affirmative.

In a garden, village, or small forest under thorough control, where the bamboos to be taken out can be more or less marked, it is of advantage to take out a few of the older culms every year; but where the prevailing conditions do not allow of such scientific supervision, I think that a rest of at least one year, between the cuttings, is absolutely necessary.

The outturn figures for this Division show a falling off since 1890, even with the periods of rest allowed. This falling off has taken place, notwithstanding the opening of larger areas by an extending road-system.

There are many clumps in this Division having the shape portrayed in Fig. VI with the youngest shoots at A.

Fig. VI.

o o o o
o o o o o o
o o o o o A

When there are new shoots at A, they are spared under the rules, and all behind may be cut. This, owing to the culms being very accessible, often takes place.

In the next year more young shoots may grow, but probably only round the younger culms at A, the rhizomes behind having died in consequence of the bamboos above them having been clean cut.

In the 3rd year (just before the next cutting) some more young shoots may grow near A, or in advance of it, which in their turn will be left, and so on. Now, the closing of the area to cutting for one year has allowed the above clump to continue its growth with vigour, and so, even should there be no new shoots formed in any one year, there is a chance that that year was closed, thus giving the clump another season in which to grow new culms before it is cut over again. It is to do away with the possibility of there being no young culms in the year of cutting that I think from 2—4 older first-class culms should invariably be left when the clump is cut over. The above opinion also holds good regarding larger clumps, except when they are thinned, and therefore in a locality under thorough supervision.

The clump shown in Fig. VI will, I know, strike some of my readers as peculiar, unless they have worked in large bamboo-producing areas under regular cutting. But still there are many such here, and they will doubtlessly be found in all areas which have undergone regular cuttings for years, under the agency of purchasers.

The question of cutting high or near the ground.

Amongst native contractors there are three chief reasons for their preferring to cut the bamboos high, *viz.*, 3, 4, or 5 feet from the ground.

(1) Because some of them believe that by doing so they ensure the life of the rhizome, thereby obtaining new culms from the part cut.

(2) Because some others give sub-contracts to one gang of coolies to cut the upper part of the bamboo (sarencha); and to another gang for the cutting of the lower part of the bamboo (balli).

The first gang goes into the forest and cuts everything high, the second gang selecting the "ballis" out of the stumps left by the first gang.

(3) Because the lower part of the bamboo being solid is not buoyant, and therefore not suitable for rafting.

As regards (1) - The bamboo stump, when free of branches, dies down at the general rate of one internode per annum, the death being caused by the percolation of water. The presence of these high green stumps keeps the root-system below alive, but unless they bear several strong branches, the new culms produced are not as thick as might be, and are often mere whips.

As regards (2)—This is a custom useless and unprofitable in itself; and a good deal has been done here to put a stop to it. It is very easy for a contractor to compel his men to make the first cut near the ground and to pay for what is brought out irrespective of the class

As regards (3) —A judicious mixture of upper and lower parts of the culms should make a sufficiently buoyant raft. This, however, is a serious objection

Sylviculturally, readers will see the force of reason (1). It is to a certain extent true but the obvious advantages of cutting low override it and for the preservation of the vitality of the clump other means must be taken, such as the leaving of the culms themselves

The Market.

I will close this note with a few remarks on the market.

Before removal the bamboos are cut into certain market-lengths, so that one culm may give 3 or even 4 market bamboos; they usually, however, give 1 or 2 only.

These bamboos are bound together, according to their class, and exported by road, railway, or water to their destination.

The local names of the different lengths, and the use to which they are put, are given in the following table:—

NAME.	Length in feet.	DESCRIPTION AND USE.
Paini ...	4—5	Solid, cut from root. Used for yokes.
Kámárá ...	4 5	Same as Paini but thicker Used for sides of carts and as pegs to tie cattle.
Lathi ...	4—6	Solid, thin, cut with root. Used as walking sticks, &c.
Bhenga ...	4— 6	Solid, thicker than lathi, cut from root. Used for bhangis and bows.
Bahi ...	6 - 7	Solid, thick, cut from root. Used in making charpoys.
Bansi ...	7—8	Hollow, cut from above bahis. Used for flutes, hookahs, &c.

NAME.	Length in feet.	DESCRIPTION AND USE.
Chaneju ...	9—10	Thin, hollow and solid combined, cut generally from the top of the culm; used for inferior quality roof-work and fencing.
Kanderu ...	10	Hollow, branches cut off by a downward stroke. Used for baskets, roof work, &c.
Sarencha ...	10—12	Hollow. Used for better class of roof-work.
Char ...	10—15	Cut from root, thick. Used in making carts, fishing rods, lances, and by bird-catchers.
Charawa ...	12—15	Thick, cut from root. Used in making ladders, cart poles, and tent poles.
Laggi or Balli...	20 and above	Thick, cut from root. Used in making bars, flag poles, punt poles, and for supporting pigeon cots.

The commonest sizes cut are italicised in the above list.

The system of working in these forests is roughly as follows:—

The jungle contractor having secured a bamboo area either cuts and collects his bamboos at some centre on a cart-road near the outer plains' boundary, and there sells them to purchasers, who come from the plains with their carts; or he cuts and removes his bamboos to a larger market, such as Jawalapur, near Hardwar, on a canal and railway; Najibabad on a railway, &c., and there he sells his bamboos to down-country merchants, or despatches them himself to some large merchants in Dehli, &c., from whom he has received advances of money to carry on his forest work.

The cost of cutting and carriage varies according to the year and season. In the cold weather a lower rate is paid for cutting than in March, at the end of which month all cutting ceases

The coolies for cutting and delivering at the nearest *parao* (local forest depôt) are paid from Rs. 8 to 15 per 100 score for the ordinary kinds, and from Rs. 30 to 40 per 100 score for *chars* and *charawas*. During March these rates may be almost doubled.

Carriage is done by means of dragging cattle, carts, and coolies. In the forests most of the carriage is done by dragging; carts are used when possible, but they cannot compete with the dragging cattle owners.

On the Ganges, and to a much smaller extent on the Ramganga, floating is largely done, the bamboos being bound into rafts in bundles tied together with bhabar grass ropes.

In consequence of the introduction of the round-sum system of sale, the royalty realized by Government has fallen a good deal. In the *chauki* system period of export, 20 to 22 rupees per 100 score were realized for this Division: now the figure lies between 12 and 15. But with the present system in force, Government does not have to defray the cost of the large establishment necessary to run the *chauki* system.

W. H. LOVEGROVE.

Wood-pulp.

In the *Indian Forester* for June, 1899, I wrote an article drawing attention to the quantity of pulp which could be obtained from the spruce in the Jaunsar Division alone. Since then I have further investigated the subject and think it may be advisable to supplement my former article, more especially at such an opportune time as this, when there is a great dearth of paper-making materials in the market.

Before proceeding further, I must note that by an oversight the disused name of the Himalayan spruce, *Abies Smithiana*, was used instead of *Picea Morinda*, the name it is now known by.

It was stated in the article referred to that paper-mills would, it was supposed, willingly purchase spruce pulp, delivered on the railway, at Rs. 3 per maund. The Manager of the Bally Paper Mills addressed me in February last, and pointed out that the price was prohibitive, as imported pulp could then be purchased, delivered at any British port, for £4-10-0 a ton, which is equivalent to Rs. 2-8 per maund. Now, however, I believe that the price has risen.

On receipt of his letter, it struck me that there must have been some mistake in my calculations, for, surely, locally-made pulp ought to be produced cheaper than that imported from a distance. I have now found the error. It was estimated that wood, ground mechanically, would yield one-third of its weight in pulp (dry). This apparently is correct if the wood is weighed green and more especially if the pieces are of small diameter: but I then took the weight of spruce as 32 lbs. per cubic foot which is its dry weight.

In the "Forester" * for June 1900, there is a most interesting article by Mr. C. W. Lyman on "The Paper Industry and Forests," with descriptions of all the different American woods used for paper and the different processes. It is there stated that, roughly speaking, a cord of spruce wood will produce nearly a ton of mechanically ground pulp.

A cord is a stack 8' × 4' × 4 and to reduce it to solid cubic feet a factor ·7 is used. If we take this statement as the basis of our calculations we find that 3⅓ cubic feet solid will yield 1 maund of pulp, whereas in my former article over 7½ cubic feet solid were taken to yield that amount.

The annual yield, if the spruce of the whole Jaunsar Division were put under systematic management, would probably be 15,00,000 cubic feet. This would produce 4,50,000 maunds of

* The "Forester," a monthly magazine, published by the American Forestry Association, Washington, D. C., U. S. America.

pulp. This greater proportion of pulp yielded would enable it to be sold at the railway at Rs. 2 per maund, *i. e.*, the same price which is now being paid for waste paper. The up-country mills would be certain to buy at this rate since the freight from Dehra would be less than from Calcutta or Bombay, and the price 8 as. per maund cheaper than the usual price of imported pulp.

If the ratio given in the "Forester" is correct, the reduction in price to Rs. 2 per maund would be made without decreasing the estimated profits of the pulp-maker who would still be able to make 20 % interest per annum on his capital.

A revised estimate of annual receipts and expenditure for any one who took up pulp-making at Dakhpathar, with a capital of Rs. 10,00,000 is given below. However, the start would have to be made on a smaller scale and the capital afterwards increased.

Receipts.		Expenditure.	
	Rs.		Rs.
By sale of 4,50,000 maunds of pulp delivered at Dehra Dun Railway Station at Rs. 2 per maund.	9,00,000	Purchase of 15,00,000 cubic feet of spruce from the Forest Department delivered at Dakhpathar at as. 5 per cubic foot	4,68,750
		Wear and tear of machinery and buildings at 10% on 3,00,000	30,000
		Manager's pay at 1,000 p. m. ...	12,000
		Assistant Manager's at 600 p. m	7,200
		Mechanical Engineer at 600 ...	7,200
		Assistant do at 300 ...	3,600
		6 Foremen at 50 each p. m. ...	3,600
		6 Do. at 30 do. ...	2,160
		120 workmen at 6 do. ...	8,640
		Carting 4,50,000 maunds of pulp to railway at as. 4 per maund per 26 miles ...	1,12,500
		Miscellaneous	44,350
		Profit on capital of Rs. 10,00,000, *i. e.*, 20% per annum	2,00,000
Total ...	9,00,000	Total ...	9,00,000

The capital required would be as follows —

	Rs.	Rs.
Cost of machinery	2,00,000	3,00,000
Setting up, leading water and erection of buildings	1,00,000	
Working capital	Say ...	7,00,000
	Total ...	10,00,000

This appears to be the prospect for any one enterprising enough to take up the industry. It would be possible, too, to increase the outturn of pulp from the Jaunsar Division beyond this, for, as soon as the annual possibility of spruce was being worked up to, other suitable woods, such as silver fir, poplars and willows would also be utilized. Once the manufacture at Dakhpathar was proved a success, other factories would be opened out to deal with the outturn from other Himalayan Forest Divisions. Then the wood-pulp yielded by the Himalayan Forests would help in a great measure to make the Indian paper-mills independent of imported pulp.

By opening up a market for the (at present) waste products of the forests, the Forest Department also would benefit very greatly, both from a revenue and a sylvicultural point of view.

The following is taken from Mr. C. W. Lyman's article above referred to.

P. H. CLUTTERBUCK.

Dehra, N.-W. P.

THE PAPER INDUSTRY AND FORESTS.

The paper industry is based upon the vegetable kingdom, the materials used in paper-making being almost exclusively of vegetable origin. That portion of the vegetable growth which is essential for paper-making is the cellulose ($C_6 H_{10} O_5$) which forms an important part of the structure of all plants.

All vegetable matter which is treated chemically to prepare it for paper-making is reduced to the form of almost pure cellulose. When prepared mechanically a large part of the lignin and other intercellular matter also remains. It is the cellulose of which the fibre consists. The proportion of cellulose fibre in different vegetable growths varies greatly, and with it their availability for paper-making. It may be said that almost the whole vegetable kingdom is available for paper making, and that the use of one species or another is a matter of selection, based on the cost of the various processes of treatment and other commercial factors.

Those fibres which are commonly used in paper-making may be divided into four classes.*

1. Seed-hairs, such as cotton, which is the only representative of the class.

2. Bast fibres as linen, jute, manila and arsonia.

3. Those derived from whole stems, or leaves, and associated with various vessels or cells not properly fibrous, as straw, esparto, sorghum and bamboo.

4. Those derived from wood.

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* This classification is taken from A. D. Little's "Chemistry of Paper-making," from which much of the information of a chemical nature has also been derived

For the purpose of this article, it is unnecessary to treat of the first three classes, except to say that a very considerable part of the paper manufactured is made from the fibres which they comprise.

The principal woods which are used for making paper are spruce and poplar; but a large number of other woods are used, more or less, according as the factors of price and relation of the mill to the source of supply vary in particular cases.

PROCESSES OF REDUCTION TO PULP.

The principal processes by which wood is reduced to pulp are the mechanical, the soda, and the sulphite.

The mechanical process consists essentially in grinding the wood after the bark has been removed. Thus all the sound wood in the tree is used, provided it is comparatively free from knots and not too small to be handled economically. The bark, branches and tops of the trees are therefore not available. In this process the whole structure of the wood is reduced to pulp and employed in making paper. Roughly speaking, a cord of spruce wood will produce nearly a ton of pulp.

The soda process is based on the solvent and saponifying action of alkali at high temperature. Poplar is used more than any other wood in the soda process, but considerable quantities of pine, spruce and hemlock are consumed in making long fibre stock, while such woods as maple, cottonwood, white birch and basswood are not infrequently made to replace poplar. The portions of the tree useful in this process are practically the same as in the mechanical. Portions of the tree of somewhat smaller diameter, however, are available, and knots are not as objectionable. The yield of fibre is about 50 % ; thus approximately two cords of wood are required to produce one ton pulp.

The sulphite process consists in heating the vegetable substance which contains fibres, with a solution of sulphurous acid in water, heated in a closed vessel under pressure sufficient to retain the acid gas until the intercellular matter is dissolved. The woods which may be used are spruce, hemlock, balsam, and other similar varieties. Any coniferous wood which is not too resinous may be used. The same portions of the tree which are used in the mechanical process are used in this. The percentage of yield is somewhat more than 50 per cent., but, roughly speaking, two cords of wood are required for one ton of pulp.

THE PULP INDUSTRY.

Ground wood, or mechanical pulp, was first made in this country in 1867, at Stockbridge, Mass. There were in 1899, 197 mills in operation in 24 States, having an estimated capacity of 3,810 tons.

It is probable that the capacity of the mills is overestimated at least 10 per cent., and an allowance must also be made for the curtailment of production during the low water season. This reduction is estimated at 20 per cent. Making these corrections, the average daily production would be approximately 2,800 tons, which may be estimated as equivalent to 2,800 cords.

The soda process was first introduced into this country in 1860, the first mill being near Philadelphia The number of mills in 1899

had increased to 21 in operation in nine States, having an estimated daily capacity of 524 tons.

Estimating two cords of wood to a ton of pulp, this would indicate a daily consumption of about 1,048 cords. This estimate is probably nearly correct. This wood is largely poplar.

The sulphite process was invented in America in 1867, but the pulp was first made by it in the United States at Providence, R. I., in 1884. The number of mills in 1899 was 68 in operation in 16 States, having an estimated daily capacity of 1,849 tons.

From the data at hand giving the actual production of sulphite during the first half of 1898, this estimate of capacity appears to be much too high, and should probably be cut down to 1.400 tons.

Estimating two cords to a ton of pulp, this would indicate a daily consumption of about 2,800 cords.

Assembling these estimates, we are enabled to form some idea of the amount of wood required for pulp-making, and assuming that the soda process requires poplar wood mainly, we have an annual consumption of other kinds of wood used in the mechanical and sulphite processes amounting to about 1,680,000 cords (counting 300 working days to the year). Or, allowing two cords to the thousand feet, approximately 800,000,000 feet in addition to 310,000 cords, or 155,400,000 feet, mostly poplar.

From this figure, representing the consumption of wood, to determine the annual cut in the United States, there must be deducted that which is brought from Canada, the quantity of which we do not know. A very rough estimate indicates that it is from 10 to 15 per cent. of the total quantity consumed in pulp-making. This would bring the cut in the United States down to from 860,000,000 to 810,000,000. While this may seem to the uninformed a large quantity, yet compared with the quantity used for other purposes, it becomes almost insignificant. Mr. Henry Gannett, Geographer of the United States Geological Survey, in his 19th Annual Report, Part 5, estimates the amount of lumber wood sawed in this country annually at 23,500,000 000 feet board measure. In comparison with this the amount cut for pulp-making is but 3·6 per cent. But a great deal of wood is cut for other manufacturing purpose, so that the total is estimated at 45,000,000,000 feet, which would bring the percentage for wood pulp down to 1·9. If 180,000,000,000 feet used for fuel is added to this, we have a total consumption of 225,000,000,000 board feet, of which the amount used for pulp-wood is but ·4 of one per cent.

The Forests of Java and their Management.

The following is abridged from a series of articles in the *Forst und Jagd Zeitung* by Forest Assessor Seibt of the Forest Service of Saxony, who was for 5 years employed in the Java Forest Department.

The forests of Java occupy about a fifth of the total area of the island, or in round numbers 25,00,000 hectares, and are

found in blocks of greater or less extent in the depressions on the north and east coasts and in neighbouring plains, as well as in the mountain ranges, which with the exception of tracts of recently erupted lava, are almost entirely clothed with woods up to an elevation of 3,000 metres, at which point tree-growth ceases.

The geological basis of the island is tertiary limestone and calcareous sandstone which form several parallel ranges of hills rising to 1,000 metres in height and running from west to east. On the low-lying north coast, and partly also on the east coast the land is mainly of alluvial origin. Sedimentary rocks are only found cropping out on the surface over about one-half the area, the rest being covered by erupted matter from the 44 volcanoes.

The prevailing rock in the tertiary hill ranges is limestone which is found either in the form of huge solitary rocks of pure calc spar, coloured yellow by oxide of iron, or as thick beds of limestone, light brown or grey in colour. Calcareous sandstones of various composition are also found. In consequence of the washing out of the calcareous binding material, the latter generally show a structure full of holes, and when the binding material has been removed in considerable quantities caves and underground rivers are of common occurrence.

The configuration of the hills is what might be expected from the tremendous disturbance caused by the eruption of the interior of the earth, which has shifted the beds from a horizontal to a vertical, or even inverted position, or has broken through and partly covered them over. A certain amount of regularity can therefore only be recognized in the direction of the crest of several main ridges, which run for many kilometres from east to west, broken only by a few peaks rising but slightly above the general level of the crest, while their side spurs twist in and out without any regularity. The broader valleys which follow the direction of the main ridges must also be distinguished from the side valleys, which either follow the lateral spurs or cut through both them and the main ridges in the form of precipitous ravines.

The rivers, without exception, run with precipitous gradients through the short side valleys to the plains or direct to the sea.

The soil formed by the disintegration of the underlying rock is, according to the composition of the latter, a calcareous clay, light red or bright yellow in colour, white or grey marl, or more or less sandy loam varying in colour. Sand, cemented together into rock, also occurs in many places, especially on the ridges. The depth of soil and humus layer is naturally smaller on the ridges than in the valleys. Humus is produced on the tertiary rocks to a much less extent than on volcanic soil as the calcareous

constituents of the former absorb a great part of the moisture necessary for its formation. This disadvantage is, however, to some extent counterbalanced by the quick decomposition of the vegetable remains.

The matter thrown up by the volcanoes is mostly trachyte with a sprinkling of other rocks, which, when they crop out on the surface, appear in the form of immense irregular blocks, or smaller more rounded masses.

Most of the volcanoes occur either as single cones or in groups, and have gentle slopes near the plains or outer hills, but grow steeper and steeper as they raise their majestic heads high above sea and land. The general ground plan of a volcano in its simplest form is a circle of which the centre is the crater and the circumference the foot of the hill, the water courses running in the direction of the radii. But though a certain amount of regularity is recognisable in the main features, the configuration of the side spurs and valleys defies all description, and each volcano has its own peculiarities. The extraordinarily steep gradients have forced the streams into their present courses, which have been gradually cut out into deep romantic valleys with precipitous walls.

The soils derived from rocks of volcanic origin are generally red loamy clays, yellow or red sandy loams, or grey or brown volcanic sands, all of greater or less depth, and covered when the forest canopy is complete, with a very deep layer of humus.

Climate.

Owing to its geographical position Java possesses a hot climate. The sun at mid-day is, throughout the year, nearly vertical; and the days are of equal length. The consequence is an evenly high temperature, though various factors tend to render it bearable.

The narrow, elongated form of the island ensures the advantages of a sea climate, since on the one hand the unequal heating of sea and land produces corresponding breezes, and on the other hand the moisture evaporated from the sea either falls on the land as rain or dew, or, in the form of cloud, serves to mitigate the intensity of the sun's rays.

There are two seasons, the east monsoon or dry season, which begins in April or May and lasts till November, and the west monsoon or rainy season, which continues for the rest of the year. During the former the sky is constantly clear, and owing to the irradiation of heat which takes place at night a heavy dew falls. In the day time the heat is moderated by a constant breeze from the east. The west monsoon brings heavy rain which lasts for days at a time. When no rain falls the sky is generally cloudy, consequently the mean daily temperature is lower during the rains than during the east monsoon.

The climate is also very considerably affected by elevation. As one leaves the coast and ascends the hills it gradually gets cooler, the average fall in temperature, according to Junghuhn, being 20°C. for every 200 metres rise. By going up a volcano one can therefore get all the advantages of a European climate. In connection with the fall in temperature other phenomena make their appearance; the air becomes rarified, the sun's rays grow more powerful, and the relative degree of moisture in the air diminishes, the latter being influenced in a marked degree by the dense forests with which the hills are covered.

Character of the Forests.

It is no wonder then that with so hot and moist a climate and a so generally fertile soil, vegetation displays a degree of richness and vigour unparalleled in any other part of the world. Not only is the number of orders, genera and species very large, but they occur crowded over a comparatively small area, though still with sufficient space, as the superabundance of light favours the growth of shrubs, climbers and trees in successive tiers.

The plants which first attract the notice of the European are the palms, with thin tall stems and high-set graceful crowns; the bamboos with slender culms and ever-whispering foliage; the plantains whose leaves, as large as they are beautiful, form a pleasing object in the landscape and add to it varied effects of light and shade; and lastly the screw pines, remarkable trees, with stems supported on countless aerial roots and palm-like crowns, bearing fruits which remind one of pineapples All the above belong to the order of monocotyledons.

Among the innumerable dicotyledonous species, the most striking are the gigantic forest trees, some with tall cylindrical stems, 40 metres to the lowest branch, some with immense buttresses, and others sending down from their lower branches aerial roots, which either combine with the main stem or form independent stems near the extremities of the branches; a single tree thus forming a forest by itself. From another point of view, one is struck by the variety in size and shape of the leaves and by the brilliant colouring and large size of the flowers and fruits of many of the trees.

The occurrence of different kinds of plants is, however, apart from conditions of soil, entirely dependent on the climate; or, in other words, the elevations.

The flat land near the northern coast is covered with low monotonous forests of *Avicennium officinate* mixed with a few screw pines, while on swampy grounds are found groups and small forests of the *Nipa* palm and mangroves, and on the banks of the river, singly or in groups, *Gluta Renghas*, which attains an immense height and girth, and *Lagerstrœmia Flos Reginæ* conspicuous from its large lilac-coloured blossoms.

In the plains and in the hills, up to an elevation of about 500 metres, teak is the principal species forming dense forests with closed canopy. Associated with it occur occasional bread-fruit trees with deeply lobed leaves, *Cratæva magna*, a gigantic tree with scarlet flowers, *Butea frondosa* with leather-like leaves and large flame-coloured blossoms, and a great number of figs. The latter are remarkably conspicuous for their broad, dense, lofty crowns, and stems so large that five men could scarcely span them, with innumerable aerial roots either clasping the stem or hanging free from the branches, and undoubtedly the most imposing form of forest tree in the eastern half of Java; while in the western half the most remarkable is *Altingia excelsa Noronha*, a tree which attains a height of 60 metres and has a perfectly cylindrical stem 35 metres in length and 2½ metres in diameter, surmounted by a beautiful dome-shaped crown. These, with *Gordonia excelsa*, and a few *Dipterocarpus* tower above all the other dicotyledonous forest trees.

With the last-named species we have already reached the hill zone, to which also some of the fig species extend. With them are associated *Manglietia glauca*, *Michelia lanuginosa*, *Bischofia javanica*, various species of *Pithecolobium*, *Pterospermum* and *Elæocarpus*, also representatives from the families of *Compositæ*, *Anonaceæ*, *Rubiaceæ*, and some others, all of which attract notice either by the brilliant colouring of their flowers, shape of their leaves, etc. In point of height, though much above our beeches and oaks, they only form the second tier in the towering vegetation of the hill forests and afford room to a varied growth of underwood. Between them Lianas spread themselves abroad, creeping along the ground, hanging from tree to tree and reaching the topmost branches of even the highest. The lowest tier is composed of shrubs and herbs, and the ground itself is covered with vegetable remains, uprooted or broken trees more or less decayed, and countless ferns, fungi, lichens, mosses and liverworts, which also grow parasitic on living trees and saplings. The higher one goes on the hills, the more numerous are the representatives of European forest trees of which the oaks are the most common, the chestnuts and maples coming next. The Casuarinas also give quite a European character to the forest, their whorled branches and long pointed bundles of needles giving them the appearance of Weymouth pines. Equally characteristic of the higher hill forests is the genus *Podocarpus*, of which *P. Cupressina* most resembles the European pines.

Very remarkable in this region is the extraordinary development of Acotyledons, especially ferns, of which certain species are found wherever there is an opening in the forest, while others chiefly affect the trunks of the trees. Where the shade is

densest their place is taken by mosses, which with countless lichens, especially *Usnea* species, form a thick covering on the stems of the trees and shrubs. Between them gleam the brilliant flowers of numerous orchids, which exhale on all sides an indescribably pleasant perfume.

As one rises higher in the hill forests one notices a constant diminution in vigour of vegetation, especially as regards variety of species and length of bole of the trees. This is most apparent on the highest peaks which project above the region of clouds. Here the trees are gnarled and dwarfed and found only singly or in small groups, with an under growth of various species of *Vaccinium*, *Myrica*, *Ranunculus* and *Geranium*. Large blanks covered with short grass (*Festuca nubigena*) are also of frequent occurrence.

The above is by no means a complete description of the Javan forests but merely a short sketch of their more striking features. An enumeration of all the orders, genera and species, would be but of little interest, but some idea of the richness of the flora can be gathered from the fact that the forest trees comprise over 200 genera belonging to about 75 different orders, and that the number of trees hitherto identified is over 800.

For many years past the Government of Netherlands-India has employed a Forest Officer who is also a specialist in botany to carry out with the aid of the rich library and herbarium at Buitenzorg an exact botanical survey of the tree flora of the island. This measure was the more necessary as the descriptions of species in the floras of Miquel, Hooker and others is incomplete and in some places incorrect. At the same time information is being collected in regard to the technical qualities of the various timbers.

Importance of the Forests.

If it is admitted that forests have a decided influence on the climate of a country, this must hold good in a special degree for the island of Java.

The difference between the climate of the forests and open country is most marked: 1st. As regards the mean temperature, which is much less in the forests, especially during the dry season and at high elevations; and 2ndly, as regards the relative moisture of the air, which is much greater in the forests, where the dew and rainfall is heavier and more frequent, than in the open country at equal elevations.

The forests also store up to the moisture of the ground and thus act as an immense sponge, preventing sudden floods and serving as a constant source of supply to springs and rivers. Of not less importance is the protection the forests afford against erosion and landslips, especially on the precipitous slopes of the volcanoes. This was early recognized by the Government of

Netherlands-India and since 1880, the re-afforestation of some of the hill areas devastated by native cultivators has been carried out on a considerable scale. In 1890 also a law was passed prohibiting the felling of trees in the higher hills.

The djati or teak is by far the most valuable of all the timbers produced in Java and is employed for almost all purposes, from backing for iron-clads, down to coffins for the Chinese. It furnishes also the best firewood and charcoal.

Among other woods, the following are the most generally used : – In ship-building, *Calophyllum inophyllum* is used for planking, *Pterospermum suberifolium* for masts, spars and yards, and *Vitex pubescens* as knee-pieces and oars. For the latter, as well for various parts of boats, are used *Pterospermum diversifolium* and *Lagerstrœmia Flos Reginæ*, while *Gluta Renghas* and the more serviceable of the figs supply wood for the dug-outs of the natives.

Wood for building is obtained from *Calophyllum inophyllum*, various *Michelias*, *Manglietia glauca* (particularly prized for its beauty and durability), *Schima Noronhæ*, *Gordonia excelsa*, various species of *Hibiscus*, *Pterospermum suberifolium*, *Acer niveum*, *Gluta Renghas*, *Pterocarpus indicus*, *Acacia leucophlæa*, *Albizzia procera and stipulata*, *Lagerstrœmia Flos Reginæ*, *Bischofia javanica*, a few species of oak and *Podocarpus*, *Casuarina montana* and *Junghuhniana*, *Schleichera trijuga* and *Adenanthera pavonina*.

In west Java where the teak is scarce, *Altinga excelsa*, though much less durable, is usually used in its place.

For underground work a species of *Ganophyllum* is principally used as well as *Lagerstrœmia Flos Reginæ*, *Bischofia javanica*, and *Altingia excelsa*.

For furniture and joinery are used various species of *Michelia*, *Murraya exotica*, *Cedrela febrifuga*, *Gluta Renghas* and *Dalbergia latifolia*, the best furniture wood of all, also *Pterocarpus indicus*, *Cassia fistula* and *Mimusops Kauki*. *Santalum album* and *Aleurites triloba*, found in east Java but now unfortunately nearly exterminated, yield a first rate material for fine carvings, and *Premna tomentosa* is employed for polished work.

Carriage and wagon builders use the wood of *Schoutenia ovata*, *Schleichera trijuga*, *Protium javanicum* and *Lagerstrœmia Flos Reginæ*, the first three being mainly used for the axles of timber carts. *Cedrela febrifuga* is employed for panels; *Vitex pubescens* for felloes and *Hibiscus elatus* for naves and spokes.

Kleinhovia Hospita is in demand for Kris sheaths and lance staves; *Murraya exotica* for sheaths and handles of

weapons, *Ægle marmelos* for gunstocks, lance staves and Kris sheaths, and *Santalum album* for handles.

For domestic utensils and agricultural implements *Cassia Fistula*, *Flacourtia cataphracta*, *Schoutenia ovata*, *Protium javanicum*, *Morinda citrifolia*, *Vitex pubescens*, *Melochia indica* and *Eugenia Jambolana* are principally used.

Nearly all species yield fuel, though some of them have no great heating power, and manufacturers prefer teak or various species of *Albizzia*. The best charcoal is obtained from *Schoutenia ovata*, *Schleichera trijuga* and *Phyllanthus Emblica*.

The economic value to the natives of the island of the numerous minor forest products is generally underrated, but it is impossible to form a reliable estimate of their value. The most important may here be enumerated.

The root bark of *Morinda citrifolia*, the young leaves and shoots of *Tectona grandis*, the wood of *Cæsalpinia Sappan*, the fruit-pulp of *Phyllanthus Emblica*, the bark of *Symplocos fasciculata* and *Vitex pubescens* and the leaves of *Lawsonia alba*.

Tanning materials are not obtained from oaks, as one would expect, although they are rich in tannin, but the inner bark of *Cassia Fistula* and *Acacia leucophlœa* is used, and in small industries various parts of the mangroves.

Among the many forest trees which yield edible fruits the following may be named:—*Pangium edule*, the kernels of which are roasted and eaten, *Nephelium lappaceum*, *Eugenia Jambolana*, *Morinda citrifolia*, *Baccaurea racemosa*, *Inocarpus edulis*, *Phyllanthus Emblica* of which the fruit-pulp is edible, as well as *Ficus infectoria* and *subracemosa*. The above are eaten by natives only; the more fastidious European restricts himself to *Artocarpus integrifolia*, *Durio zibethinus*, *Garcinia Mangostana* and *Lansium domesticum*, all of which are cultivated in gardens. The first two form an important food staple among natives, and there is a large trade in the two latter.

Oils are obtained from the seeds of *Pangium edule*, *Protium javanicum*, *Aleurites triloba*, *Schleichera trijuga*, *Adenanthera pavonina* and *Inocarpus edulis*. Gum and rubber from the bark of *Albizzia procera* and *Ficus elastica*, and wax from the bark of *Ficus subracemosa*. Cotton is yielded by the fruits of *Cratæva magna*, though of less value than that produced by the cultivated *Eriodendron anfractuosum*. Among the various products the following may be noted. The leaves of *Morinda citrifolia* and the leaves and fruits of *Gnetum Gnemon*. The flower stalks of *Arenga saccharifera* yield sugar and the pith sago. For the preparation of "Sajor," a

sauce used with rice, the following are employed; the kernels of *Pangium edule* and *Artocarpus incisa*, the tubers of *Dioscorea hirsuta* and the roots of several *Scitamineæ*.

The products of medicinal value yielded by the forests are very numerous. Decoctions of the leaves and stalks of most species of *Hibiscus* are largely used, as well as the fruits of *Ægle marmelos*, the bark of the Dorian, the bark of *Simplocos fasciculata*, shavings of the wood of *Strychnos colubrina*, the bark of *Cinnamomum Sintok*, the seed of *Cassia Fistula* and the roots of the *Scitamineæ*.

Violent poisons are prepared from the milky juice of *Antiaris toxicaria* and from a decoction of the root bark of *Strychnos Tieute*.

Finally, there are numerous minor products indispensable to the natives, such as alang-alang grass for thatching, various bamboos for basket-work, and bark for walls and roofs of huts, teak leaves for thatching, the bark of *Gnetum Gnemon*, *Artocarpus incisa* and various species of *Hibiscus* for string or rope, as well as the stalks of *Arenga saccharifera* and some of the rattans.

But this by no means completes the sum of the value of the forests of Java. The cultivation of coffee, tea, tobacco and most of the native food staples depends on the capital of growth-producing forces stored up in the soil during the course of centuries. Millions have thus been wrung from the forests, all of which should be set down to their credit. Lands, which after many years of cultivation become exhausted, are abandoned and left to be gradually re-clothed with forest, until after the lapse of many decades they have stored up sufficient humus to be again suitable for cultivation.

When one considers that there is little room for art in the colonies the value of the forests, from an æsthetic point of view, can hardly be overrated. The majestic forest, in all its richness and glory, supplies what is wanting, and affords the truest and purest enjoyment to those who have to put up with the daily annoyances and privations of life in the tropics, and who have not yet lost all sense of feeling for the beautiful in nature.

In the social polities of the natives the forests play an important rôle. Owing to the immigration that has taken place during the past thousand years of settlers of Buddhist or Brahmin and later of Mohamedan origin, all more intelligent than the aborigines, the latter have been gradually driven from the sphere of trade and commerce to agriculture and have thus become more or less dependent on the forests. The latter had, therefore, generally come to be regarded as common property until towards the middle of the last century the teak forests

were taken possession of by the Dutch East India Company. For this reason thefts of timber and unauthorized cultivation are offences which it is almost impossible to eradicate.

Owing to his intimate acquaintance with the forests the Javan is a very valuable workman, and his quickness of observation makes him specially useful as a guide. With steadily increasing cultivation and clearing of forest areas he is learning other manners and customs and now demands conveniences and luxuries previously unknown to him. He has thus become a considerable consumer of Dutch produce and, consequently, a more pliant instrument in the hands of his rulers

(*To be continued*).

II.—CORRESPONDENCE

III.—OFFICIAL PAPERS AND INTELLIGENCE.

The Ground-nut Crops near Panruti, South Arcot, Madras. *

Mr. C. A. Barber, Government Botanist, Madras, has recently published in the form of a small pamphlet, the results of his investigation into the cultivation of ground-nuts in Madras. The principal questions which Mr. Barber set himself to answer were the following:—

1. *Is the variety cultivated an inferior one?*
2. Is rotation of crops practised?
3. Are there any diseases worthy of attention?

1. *Kinds of ground-nut grown.*—In view of the generally accepted charge of conservatism brought against the Indian agriculturist, it is particularly noteworthy to find that two or three years ago something like a revolution occurred in the introduction of a new variety called the *Mauritius ground-nut*; so much so that this latter variety has altogether ousted the original "country seed." This clearly shows that if a new seed is proved to be of superior quality, the ryot is quite capable of appreciating it.

The chief differences between the two are to be found in the greater hairiness and longer internodes of the old variety, and in the fact that, whereas the old variety never has more than one pod developed from each node, the new normally has two and not infrequently three or four. The new variety matures two months earlier, while its pods are placed not nearly so deep in the ground. These are sufficiently solid advantages without of necessity adding a greater freedom from disease; the new variety has, at any rate, not brought any diseases with it, is much less attacked by *Ver puchi*, and is freer from *Surul puchi* and *Kambli puchi*.

2. *The question of rotation.*—The investigations made by Mr. Barber clearly show that the charge of continuous

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* Department of Agriculture, Madras, Vol. II, Bulletin No. 38. The ground-nut crops growing near Panruti. Report by C. A. Barber, Esq., Govt. Botanist, Madras, 1900. Price 1 anna 3 pies.

cropping brought against the cultivators is well founded. The answer usually given to general enquiries on the subject was that a rest of one year was allowed in every four or five. "Of scientific rotation it may safely be asserted, as regards ground-nuts, there is none, although the interval of rest allowed to the land shows that the ryot is aware of its advantage."

3. *Diseases affecting the crop.*--The following is Mr. Barber's report regarding these :—

I noted four diseases affecting the plants, one of which is new to me and difficult to understand, although, perhaps, long existent in the fields. In this latter case the plants are healthy, and I take disease to include any cause which seriously affects the yield of isolated plants in comparison with their neighbours.

I shall refer to (1) Kambli puchi, (2) Surul puchi, (3) Ver puchi and (4) Clump. The greater part of my time at Panruti was devoted to the study of the first two of these pests as being the most evidently destructive. I was anxious, if possible, to obtain these insects in all their stages for their definite scientific determination, and I am glad to be able to report that I was successful in so doing.

(1) *Kambli puchi.*—This pest was found devastating the fields on the high, dry, red soils south of the river Gadilam. I did not meet with it elsewhere or hear it reported from any other place. The appearance of the fields was truly alarming, and the roadsides were clothed with filmy lines moving in the breeze, seen on examination to be made up of multitudes of the young hairy caterpillars on the march. In several cases the attack was so severe that nothing of the plant remained but its skeleton, all leaves having been removed, and nothing could be seen but a moving mass of caterpillars looking as if they had been emptied upon the plant from a small pail. My first endeavour was to discover the chrysalis into which the caterpillar changed. Holes dug in the ground among the bushes and in the dry, hard banks of earth between the fields were alike unproductive. But a careful search in the soft soil among the roots of the *Vitex Negundo* bushes lining some of the fields was rewarded by the discovery of a number of pupæ, many of them covered with hairs. These I buried in earth in chatties covered by a mosquito-net frame work, and each night collected a few white-spotted moths with barred red and yellow bodies. I found a number of dead moths of the same kind among the stricken bushes, and near the *Vitex Negundo* bushes the ground-nut plants were much more severely attacked than elsewhere. The presumption was thus strong that the moths collected were the imago stage of the hairy caterpillars. My stay at Panruti was not long enough to enable me definitely to prove this: but I secured a number of large caterpillars and successfully caused them to change (in chatties

half filled with earth) into hairy chrysalis-cases apparently identical with those dug out on the field banks. Since my arrival at Ootacamand one of these pupæ has developed into a distorted moth with the characteristic markings described above.

I feel therefore justified in assuming that I have obtained the various stages in the life-history of the Kambli puchi. The species has been conditionally determined as *Aloa lactinea*, Cramer.

It is quite improbable that swarms of caterpillars such as I have described should themselves continue for any length of time to be free from disease, but I did not, at the time of my visit, observe any fungus preying upon them in the form of an epidemic Their diminution or disappearance will probably have followed the heavy monsoon rainfall which visited the district immediately after I left. Their destructive power, while it lasts, is very great. As preventive measures I would suggest—

( ) The eradication of the hedges bordering the fields. I am told they serve no useful purpose; the small hard red-earth banks will separate the fields equally well, and do not provide a congenial burrowing ground for the old caterpillars

(*b*) The construction of small trenches with perpendicular sides recommended by Mr. Subba Rao has frequently been found an effective bar to the migrating armies' progress.

(*c*) The use of Paris green or some other cheap arsenical spray would probably be worth trying while the pest is serious.

(*d*) The collection of chrysalides from the banks should undoubtedly be attempted.

(2) *Surul puchi (or Mudu puchi).*—This pest is referred to in the Bulletin already quoted as probably a minute microlepidopterous moth. It is far more serious than the Kambli puchi and occurs wherever I have seen ground-nuts growing.

An examination of plants just emerging from the ground will show yellowish dots upon the leaves. These are the first sign of attack and, I presume, are caused by the insertion of the eggs inside the leaf tissues. Later on the tunnelling of the grub causes the leaf to fold over the place attacked. The latter turns black, and a white film binds the converging leaf surfaces together. In this secure hiding place the grub passes into a minute chrysalis. At this stage the presence of the pest is at once detected by the blackening of the field. Later on the leaves dry up and fall off, some fields which I examined being completely defoliated and the ground covered with the dead black leaves. The latter case was, however, rare. An unequal struggle was usually kept up between the plant and the attacking pest, new leaves being put forth which would be

attacked in their turn unless relief came in a welcome shower of rain.

The fields where the attack was at all severe were infested by crowds of minute, active, dark grey moths with a white patch near the end of each wing, which dashed in all directions on being disturbed. I was early led to connect these with the surul. At night literally millions of the same or a similar moth collected on the bungalow walls which were illuminated by my lanterns. The active flying period of these moths is therefore probably during the night. In the West Indies I first succeeded in identifying the sugarcane moth by collecting specimens in my drawing room and comparing them with those reared from captive chrysalides. This succeeded many days of fruitless search in the fields.

A collection of surul-attacked leaves carefully freed from moths was placed in a bottle with muslin drawn across the opening, and I thus easily obtained numbers of the same small moth. This then is evidently the imago of the surul pest, a minute microlepidopterous moth as already suggested.

As to its distribution, it is practically universal, being abundant all the way to Tiruvennanallur, although I met with less of it on the red soils some miles south of the Gadilam river. The fields in this locality were, however, more isolated and were also free from Kambli puchi. In very few instances were the plants actually killed, and all stages were met with between such total destruction and a slight attack. In some fields the blackening was seen to occur in patches, in other cases they assumed a uniform ashen colour. Even in fields apparently quite healthy, a very little search would bring to light a few distorted leaves. The pest may thus be regarded as always ready to attack plants weakened by drought or some other cause. It may be regarded as one of those diseases which occur wherever large areas are planted with the same plant. Its rate of growth is probably very rapid, and it would be able quickly to spread over great tracts. It is therefore one of a dangerous class. It would be interesting to work out the effect of the heavy rains of late October. They should place the plants in a favourable position in their struggle.

The grub appears to be a miner, *i.e.*, living within the tissues of the leaf. It is therefore much more difficult of access than the Kambli puchi. I would suggest the spraying of the young leaves at intervals throughout the growing season. This should prevent the laying of the eggs. It is not, however, very likely that the ryots will be induced to do this because the timely shower is the best remedy, and they would be constantly expecting it until the plants were thoroughly infested.

It may be a question for the ryot to determine whether a partial irrigation during the season of drought would not pay. Many of the surul-infected fields I examined were capable of irrigation. One field only did I come across where a constant irrigation had been kept up. It was on poor land in the midst of suffering fields. The crop covered the ground well with a dense, green mass of leaves and a selected plant showed 109 fertilised ovaries

(3) *Ver puchi.* There was little or none of this pest present at the time of my visit. I constantly enquired for it, but was told that it would appear, if at all, in three-to-four-months old plants In the few fields of that age none was met with. I was told by others that, since the introduction of the Mauritius seed, Ver puchi had practically disappeared. In one case I dug up the larva of a cockchafer. This was stated by some ryots to be the Ver puchi, but it was denied by others.

(4) *Clump.*—In many fields I met with curious, stunted plants which presented all the appearance of a specific disease. They appeared upon examination, however, to be perfectly healthy, and I found no trace of injury upon them. They grew in small patches or between perfectly normal spreading plants. I measured a series of adjoining plants, the ordinary branching ground-nut plant of 32 inches in diameter growing side by side with a small tufted specimen 3 to 4 inches across, the numbers of branches and leaves were apparently the same on both sets of plants, but were of course much smaller on the stunted specimens.

This curious dwarfing or "bush form" may be due to a variety of causes Enquiries from the ryots elicited the fact that they had noted these plants for many years past. As to the cause of such a manner of growth the wildest answers were given, but two ryots in widely separated places said it was due to the planting of immature seed—the only intelligent answer received. I do not think that this is likely to be the case I would rather suggest that some definite disease has attacked these plants or that a dwarf variety is gradually developing in the fields. These plants bear a few well developed pods: they do not anything like cover the ground, a part of a field attacked appearing as if dotted over with minute, well-trimmed, rounded bushes. Whatever the cause of this habit may be, it is worth attention because of the great diminution in yield of nuts and the prolonged exposure of the soil to the sun. It should be impressed upon the ryots that if they sow seed from such plants, they will probably increase the number in their fields. And I would also suggest that a careful experiment be conducted to determine—

(1) Whether the clump form is a variety true to seed—be its cause a hereditary disease or not.

(2) Whether it can be produced by the sowing of immature seed from healthy, normal plants.

I observed the same character in ground-nut fields at Emappur near Tiruvennanallur and should therefore regard it as widespread.

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Lastly, one point of interest which forced itself on my attention may be alluded to. This was the effect of the avenue trees along the roadside upon the crop. In the majority of cases the evil effects of the trees was so well recognised that strips of land 5 to 10 yards wide were left unplanted or planted with other crops. It was on my ride to Tiruvennanallur that I first noted the varying effect of different kinds of trees upon the ground-nuts. Of the five species especially noted, black plum and tamarind were the most harmful, mango and jack intermediate, while the banyans appeared not to be at all prejudicial. These facts appear to be well known to the ryot. Whereas with the first four trees mentioned it is usual to avoid planting ground-nuts under their shade; in the case of the banyans I repeatedly found the cultivation extending uninterrupted right up to their trunks; and what is more surprising, the plants were larger and greener than in the rest of the field. I enclose a diagram of a striking instance of this kind which can at once be located by any one interested in the subject—namely, at the 107th milestone along the north road out of Panruti. The main road is lined by tamarinds, whereas a side road at right angles to it opposite the milestone is bordered by an avenue of banyans. We thus have the two sides of the corner field bounded by tamarinds and banyans, respectively. In the former case there is a strip of waste land not cultivated: in the latter, the cultivation extends right up to the trees, and under their shade the ground-nuts are greener, taller and denser. It is just possible that the plants under the shade of the banyans may tend more to leaf than to seed. This can easily be determined on the spot at harvesting. The matter is of some interest because of the well known popularity of the different species of Ficus as coffee-shade trees. We may have here an important auxiliary in fighting diseases attacking the ground-nut. It may be found in the future that scattered banyans in the fields will render the plants more healthy. The experiment is worthy of consideration.

V.—SHIKAR AND TRAVEL.

A Trip to the Gokteik Gorge on the Mandalay-Kunlon Railway.

We left Mandalay by the newly-opened section of the Mandalay-Kunlon Railway on a sweltering day in June at 1 p m. in the afternoon. The train, which I suppose is the forerunner of the (future) "Shanghai and Pekin Express," does not run at a high rate of spe.d, taking as it does 5½ hours to cover the distance of 39 mil s, between Mandalay and Maymyo, where passengers stop f.r the night. Its metre gauge carriages are, however, the b.st appointed in the east, and compose a veritable *train de luxe,* with a restaurant car for 20 passengers; thus showing what the Burma railways can do when they try in making one wish that the like improvements were more often introduced elsewhere.

At Sedaw, 19 miles from Mandalay, the train commences the ascent of the escarpment of the plateau on which Maymyo is situated. This is surmounted by five miles of zigzags with a gradient of 1 in 25, there being no less than four reversing stations.

From the summit on a clear day a fine view is obtained of the country round Mandalay and the steep hills at Sagaing on the far side of the Irrawaddy.

A few miles before reaching Maymyo the railway runs along a pretty stream not unlike the Re naddy in the E. Dun: this

stream looks as if it should contain fish, but there are practically none but a few small laboos. Elsewhere in the Shan States there is fair fishing in some of the streams, but the practice of dynamiting the pools, even by those who ought to know better, is not an unknown practice, which, I hear, has recently almost exterminated the fish in the formerly well-stocked rivers of the E. Dun.

Maymyo has advanced considerably since the following description was written a few years ago:—"It stands in a shallow valley surrounded by low jungle-clad hills. The clearing is perhaps 3 miles long by one and a half wide, but there always appeared to be more jungle than clearing about the place.

"The station is traversed crosswise by two rough tracks called by courtesy roads, and is surrounded by what is called the Circular Road. This road, but recently constructed, is six or seven miles long, and passes mostly outside the clearing, being consequently bordered in many places on both sides by thick jungle.

"At regular distances there stand by the wayside tall posts bearing numbers These mark the situations of houses, which, it is hoped, will, in the future, be built in the allotments which they represent."

Besides the railway station, which had been built some time before the railway was opened, and the bazaar—"the station contains the court house, the district bungalow, and the post office, half-a-dozen European houses, scattered up and down the clearing, and the club."

Since this description was penned, Maymyo has advanced greatly: there is an excellent system of good roads for driving and biking, and water works are in progress, which will supply water to nearly every house in Maymyo.

The numbered sites, of which there are over 100, have mostly been taken up for house-building, and several new houses are being built. There is an excellent polo ground and golf course, several lawn-tennis courts, and a comfortable club in the centre of the station. The circuit house has now been altered into a residence for the Lieutenant-Governor. Although only 3,500 ft. above sea level, Maymyo enjoys a temperature of 12 to 20 degrees below that of Mandalay during the hot weather, and the climate affords a most welcome change to those whose energy is exhausted by continuous residence in the enervating climate of most parts of Burma. Of all Indian hill stations Pachmarhi is said to resemble it most.

By a welcome concession Forest Officers, if they can arrange it without detriment to their work during the rains, (and in Upper Burma there are as yet few of whom this cannot be said), are

allowed to spend a month or six weeks at Maymyo in order to recruit. Until now few have taken advantage of this concession, but this has been due chiefly to the former inaccessibility of the place and the lack of house accommodation during the rains. However, now that the railway is opened and new houses are being built, doubtless many will avail themselves of the privilege.

As regards vegetation, Maymyo in some respects resembles *Dehra Dun*. Nearly everything, whether tropical or temperate in its natural habitat, will grow, and one may see pines, india-rubber, sissu, mango trees and oaks growing and flourishing where they have been planted along the roads, or in the forest garden. Of English fruits, peaches and strawberries do well, as do plantains, and probably lichis and loquats. The climate, however, is too warm for cherries and apples, though plums and pears give good promise of eventually succeeding.

Eucalyptus, especially *citriodora*, grows very well, and it is likely that the *casuarina* and Australian silver oak (?) which flourish so well on the Mysore plateau, would also succeed here. The low hills surrounding the station are covered with oak forest, chiefly coppice, the result of deserted taungya cultivation; large areas of dense high forest being rare. Much of this is being reserved, and will be worked as coppice for the supply of fuel to the station and to the railway. The railway is at present open to Nawngkhio (pronounced Noungchaw by Burmans), 35 miles beyond Maymyo, at the edge of the plateau, beyond which the ground falls steeply to an affluent of the Myitgne river. In this river is the celebrated Gokteik gorge, now in process of being spanned by a viaduct, the loftiest of its kind in the world. We left Maymyo one fine morning by the daily train shortly before eight o'clock, arriving at Nawngkhio about midday. The railway runs for most of the way downhill, through the usual oak forest, stopping at two stations on the way. At Wetwun, 12 miles from Maymyo, there is a pretty stream, on the banks of which are patches of almost virgin forest, unlike the surrounding hills, all of which bear traces of having been heavily cut over for *ya* cultivation.

Nawngkhio is situated on a plateau, at the edge of the great valley which contains the Gokteik gorge. Here the passenger train stops for the present. Through the courtesy of one of the engineers we were given a trolly, on which we swiftly descended in less than half an hour to the head of the viaduct across the gorge: the average gradient is one in forty, and these engineering works are rather heavy, there being several long embankments and deep cuttings. The scenery is very fine, and one can see it well from the railway which, as it winds down the valley, affords many distinct points of view. One is reminded of the Saxon Switzerland and the highlands of Bavaria, and the resemblance

would be the more striking were it not for the absence of firs and pines.

The bridge or rather viaduct across the river, for it crosses immediately over a natural bridge, is not very striking at first sight. The natrual bridge is broad, and one does not realise that on either side of it, 600 feet below, a river is flowing in a gorge so narrow that it is almost hidden by the dense forest growing on its banks, so that one appears to have reached the lowest point of the broad valley. And, indeed, in time past the natural bridge may have been merely a part of the valley floor which was then some 600 feet higher than it is now. For it is believed that the river when it had cut its way down to the porous limestone formation, where these natural bridges are usually found, gradually sank through it without cutting it entirely away, till it flowed underground for many miles. Finally, the water dissolving more and more of the limestone, the valley became undermined throughout its length and gradually fell in, leaving a narrow gorge spanned here and there by these so-called natural bridges. Arrived at the foot of the bridge, the Resident Engineer who is supervising its construction on behalf of Government, most kindly furnished us with a guide to show us the path down to the gorge and the cavern, where the river disappears under the natural bridge.

In half an hour we had descended by a steep but well made path through thickly wooded forest to the bottom of the gorge; and here both the temperature and the luxuriant vegetation reminded one that the temperate climate of the Maymyo plateau had been left far behind, though rather curiously ground orchids of large size are not uncommon. Ferns of various kinds, including maiden hair, were abundant, while on the other bank was a small clump of what appeared to be *dracænas* (tree lilies).

The stream itself is only a few yards broad, and the volume of water was not very great when we visited it in June; but here, being so close to the cavern into which it disappears, a large body of water is probably running underground.

From the point where the path meets the stream, the way leads over huge boulders for two or three hundred yards to the foot of the natural bridge itself. Here in a precipice some 200 feet high which crosses the gorge from side to side, appears a vast semi-circular arch about 100 feet wide and of the same height.

Passing through this natural gateway one finds oneself in a large domed cave, at the further end of which a small tunnel curving round to the left provides a channel for the water.

In the hot weather when the river is low, it is possible to traverse the whole distance along the bed of the stream and arrive where it again meets the light on the other side. On

either side of the cave are terraces of shallow pools fed by streams of water falling from the roof above; almost in the centre is a tall isolated rock which appears to have been formed entirely by the lime deposited from the water continually falling on its apex—a vast stalagmite in fact.

In the pools are found leaves, fragments of sticks, &c., which, after a short time, become entirely petrified or rather thickly encrusted with lime, but showing all the markings of the original outward structure.

The journey up the path to the railway viaduct is toilsome, and we were glad to rest under a lofty and a spreading chestnut (*castanopsis?*), watching the American workmen placing the columns and girders of the viaduct into position

The viaduct itself is 2,200 feet long and 320 feet above the highest point of the natural bridge: the chief spans are 120 feet apart between the towers, which are perhaps 50 feet long at the top, thus making about 12 principal spans, not including some short ones at the southern approach

The towers are constructed of 4 box girders forming the outer columns, well traced with lattice girders and wind ties. Although there is an entire absence of more ornament, the effect is remarkably fine.

There is no appearance of heaviness or undue fragility, but only the harmonious result due to the successful adaptation of the capacities of the material to the end required. Hence the viaduct, though striking, is most graceful, and seems to span the gorge without effort. When finished it bids fair, from the artistic point of view, to be one of the most successful steel bridges that have ever been built. It is interesting to know that though the contract has been undertaken by an American firm and the details of the construction are all on American standard plans, that the main principles of construction and general outline of the bridge were designed in London.

The viaduct will, if no untoward accidents occur, be completed next November. At the time of our visit the workmen were erecting the 9th tower. There are about 40 American bridge-builders, exclusive of engineers, employed on the work, and when it is in full swing, a tower can be erected to a height of 300 feet in one day, and the connecting girder placed in position in three; though, subsequently, of course, they require to have the riveting completed, and to be coated with paint It is most interesting to watch the workmen.

The work proceeds quietly and expeditiously, without delay and without noise and bustle to its appointed end. Were it possible for the somewhat casual Burman to copy the methods of these highly skilled workmen, the Forest Officer's task in this country would indeed be an easy one.

The day was now drawing to a close, and after walking out on the bridge to the end where the gigantic travelling crane thrusts forward a huge arm over the gulf below, from which are suspended the columns and girders of the 9th tower that are being bolted into position, we were hospitably entertained by the Government Resident Engineer. Here we were shown numerous maps of Upper Burma, East China and Siam. It is a pity to think that to an unprofessional observer the French surveyors and cartographers in Siam, and even the German compilers of maps in Leipsic, turn out work which is superior to our own; for the topography of Upper Burma, especially to the north, is still exceedingly incomplete, there being large tracts of absolutely unexplored country, so that many of the published maps resemble the famous chart described in the *"Hunting of the Snark."* *This is due to the fact that Upper* Burma has never yet been systematically surveyed as a whole. The railway, in its political and strategical aspects, was discussed with our host: it is by no means certain, in spite of an inspired paragraph in the *Pioneer*, that it will not be carried beyond Lashio; though for a long time to come the possibility and profitableness of a large through traffic will remain a matter for speculation. Afterwards we returned in the evening by trolly to our dâk bungalow at Nawnkhio. The ascent occupied nearly two hours as against less than half an hour in descending. The next day we returned by the daily passenger train to Maymyo.

Thus ended one of the most interesting and delightful trips I ever experienced in the east, and one which can be thoroughly recommended to anyone with a few days leave to spare.

Although there is a dâk bungalow at Nawnkhio, yet the traveller will have to provide all his own requirements, except tables, chairs and beds, while those who wish to visit the gorge and cannot find a trolly available should take saddles and bridles with them, for ponies are obtainable in the village

TONAYA.

VI.—EXTRACTS NOTES AND QUERIES.

Ageing of Timber by Electricity.

The Nodon-Bretonneau process, which is said to impart to timber all those qualities which it formerly only attained by long storing, is founded on the Daniel experiment, which any body can readily execute. Into a glass tube bent up at both ends, pour acidulated water, and submerge in it a drop of mercury. Next, the tube is placed exactly horizontal, and left alone. When the wires of a battery are now placed in the two end openings, the quicksilver drop will be seen to move from the positive pole to the negative one. In the same manner the sap is driven

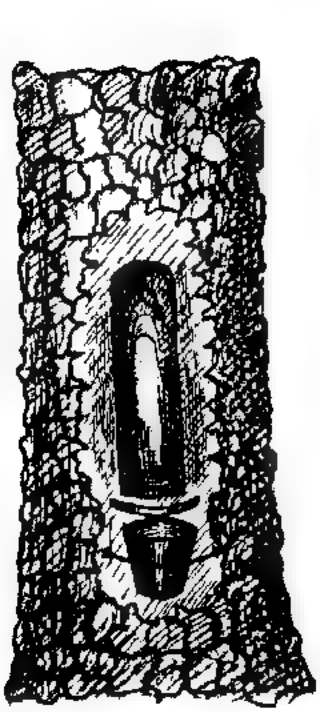
from the wood to one side by the electric current, and finally expelled. This is done in a large wooden vat, in which a frame overlaid with lead forms a double bottom, and is connected with the positive pole of a dynamo, over the wide apertures of the frame, which can be moved in a vertical direction by a hydraulic worm, the timbers to be treated are piled up. Over this square boxes of small height, whose bottom is formed by felt and linen, are placed, which, filled with water, represent porous vessels, as it were. By lead fittings the water receptacles are connected with the negative pole of the source of electricity. The vat is now filled with the liquid chemical preparation, which, gradually entering the wood, is to crowd out the sap or rather to replace it. The wood, piled up in the vat, is not completely covered up by the chemical liquid, so that a space of several centimeters remains between its surface and the felt bottom of the water receptacles. By means of a current of steam running through serpentine pipes fitted at the bottom of the vat, the chemical liquid is constantly kept at a temperature of 30 to 40° C. The electric current passes through the whole thickness of the timber, between the frame surrounded with lead, over which they are piled up, and the porous water receptacles standing on top. Under the action of the current, an endosmose, as it were, takes place in the timber, by the chemical preparation entering the pores of the wood and crowding out the natural sap, which makes its appearance on the surface of the chemical liquid. The operation is finished in a few hours. The timber thus treated is allowed to dry in the open air for a few days, and the drying is completed in chambers with graduated temperatures. Immediately after leaving the chamber the wood may be worked up.—*Neueste Erfindungen und Erfahrungen.*

The Xylosote Process of Wood Preserving.

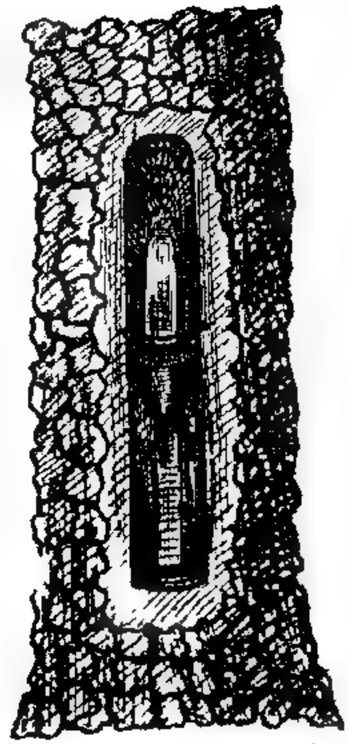
The Xylosote process of wood preserving was invented by Mr. Fritz Hasselmann. It consists in boiling the wood under pressure varying from 15 lbs. to 40 lbs per square inch in a solution of metallic and mineral salts. The impregnating liquid consists of a solution of the sulphates of copper and iron (crystallised together in the proportion of 80 per cent. of iron to 20 per cent. of copper), and alumina and "kanit," a salt mined at Stassfurt, Germany, consisting chiefly of sulphate of potash and magnesia, and chloride of magnesia. The sap is dissolved and carried off in the liquid; the copper destroys any germs of decay that may be present in the wood, while the iron forms a chemical combination, insoluble in water, with the cellulose or woody fibre. When the timber has been dried, the salts are not left in the form of crystals in the pores, ready to be dissolved out again by rain. Experiments made by Dr. L. Roesler, of Klosterneuburg, near Vienna, on props used in

vineyards, show that the process is very successful in protecting wood from decay. Mr. J. Bleibinhaus, Superintendent of the Impregnating Works of the Royal Bavarian Government Railways, reports that sleepers of soft woods, hardened by this process, are in all respects equal to oak. The process has been adopted by the Imperial and Royal State Impregnating Works, Kerchseeon, Bavaria; the South Germany Impregnating Works, Haar, Bavaria; the North German Impregnating Works, Berlin; the Upper Bavarian Mining Company, Limited, Penzberg; the West Bohemian Mining Company, Limited, Sulkow; Mr Barshall, New York; Messrs. Hofig and Co., Libau, Russia; V. Shefftel Works, Wien-Flondsdorf, Austria; and Messrs. G. Gregersen, Budapest. The English works are run by the Xylosote Company, of 6, Red Lion-court, E. C., and are situated at Pitlake, Croydon.—*Engineering.*

PLATE I



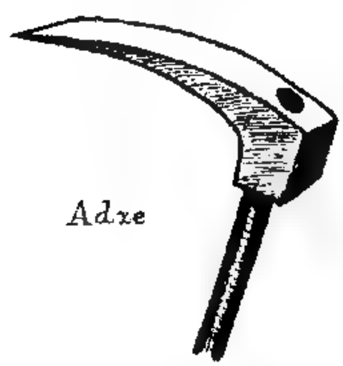
1st year, cut or blaze 2ft high.



2nd year, cut or blaxe 4ft high

Section

Gouge chisel



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THE

INDIAN FORESTER.

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The Manufacture of Turpentine and Colophony at the Imperial Forest School, Dehra Dun.

In April 1888, the question of manufacturing resins and turpentines, particularly with a view of establishing a trade in turpentine, was first seriously taken in hand at the Imperial Forest School. In that year Dr. H. Warth was specially appointed to make the necessary inquiries; and in consequence he caused a number of chir (*Pinus longifolia*) and kail (*Pinus excelsa*) trees to be tapped in the Jaunsar forests. In October of the same year a quantity of the crude resin was received at Dehra Dun, and was worked out in a square still. Some of the outturn was sent as samples to Germany and to the Calcutta and Mysore Museums; the remainder, together with some of the crude resin, being sold in the local market at Dehra. The crude resin fetched Rs.2-2-0 to Rs.4-4-0 per maund; the colophony, Rs 4 per maund; and the turpentine oil, Rs.22-4-0 per maund, or Rs.2-6-9 per gallon. The colour of the colophony was dark, and the oil was by no means clear.

In May 1889, the still was removed to Deoban above Chakrata, 9,000 feet elevation, where it was set up to be worked under the supervision of the Range Officer, in charge of the Deoban Range. The arrangement, however, was not a success. The distiller apparently gave much trouble; the work was not sufficiently supervised, with the result that the boiler was very soon injured and began to leak Consequently the machine was returned to the Forest School at Dehra Dun in March 1890.

A new cylindrical still, which is now in use, was then ordered from Roorkee by the Conservator of Forests, Mr. C. Bagshawe. This was received in June 1890; and in October I was directed by Mr. J. S. Gamble, the then Conservator, to set up the apparatus and to start work. This was accordingly done, and on the 11th November 1890 distillation commenced. In the beginning some difficulties were encountered, and a few accidents occurred, and these will be referred to later on. Work, however, has now been going on regularly almost without interruption during the last ten years, and at the present moment, in the School Factory, there are

three separate sets of apparatus at work. Moreover, resin-tapping operations now form a regular feature of the working of the Jaunsar Chir forests, and provisions for the carrying out of these works are included in the Working Plans. The crude resin is brought down to Dehra, and, in the distilleries erected at the Imperial Forest School, turpentine and colophony are manufactured.

The present system of tapping for resin has been adopted from the French, and a full and interesting description of the same by Mr. F. Gleadow, Deputy Director of the Forest School, appeared in the appendix to the January Number of this Volume.*

A sketch, Plate I, is here given which will explain the process.

Before the crude resin is put into the still, its impurities are removed by liquefaction and filtration For this purpose an iron caldron is used (*vide* Plate II), 2 feet 6 inches in diameter and 1 foot 3 inches deep. Four tins of crude resin, weighing 2 maunds, are put into the caldron at one time, and are heated to a temperature of from 50° C. to 63° C. (122° to 146° F.)

As the crude resin in the caldron becomes heated, it is taken out by means of an iron ladle and passed through two sieves: one coarse, the other fine; the meshes of the former being one-eighth of

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* "The present system of tapping, which is adopted from the French, is as follows:—The outer bark is first of all removed for a space of several feet in height and about 2 feet in breadth; then an incision is made near the base of the tree, 1 foot long, 4 inches wide and 1½ inches deep, the instrument used being the native adze. A gouge chisel 5 inches wide is then driven into the tree just below the bottom of this incision; into the curved cut thus made a strip of zinc 5 inches long and 1½ inches wide is driven by the handle of the gouge; this forms a lip which guides the resin into the pot placed below to receive it. This vessel is hung on a nail, a piece of string passes round it and is fastened to nails on either side. The second year, as the blaze is extended upwards, the pot fits into it, and is supported by a nail under the bottom, the top being held by the zinc lip and the string dispensed with.

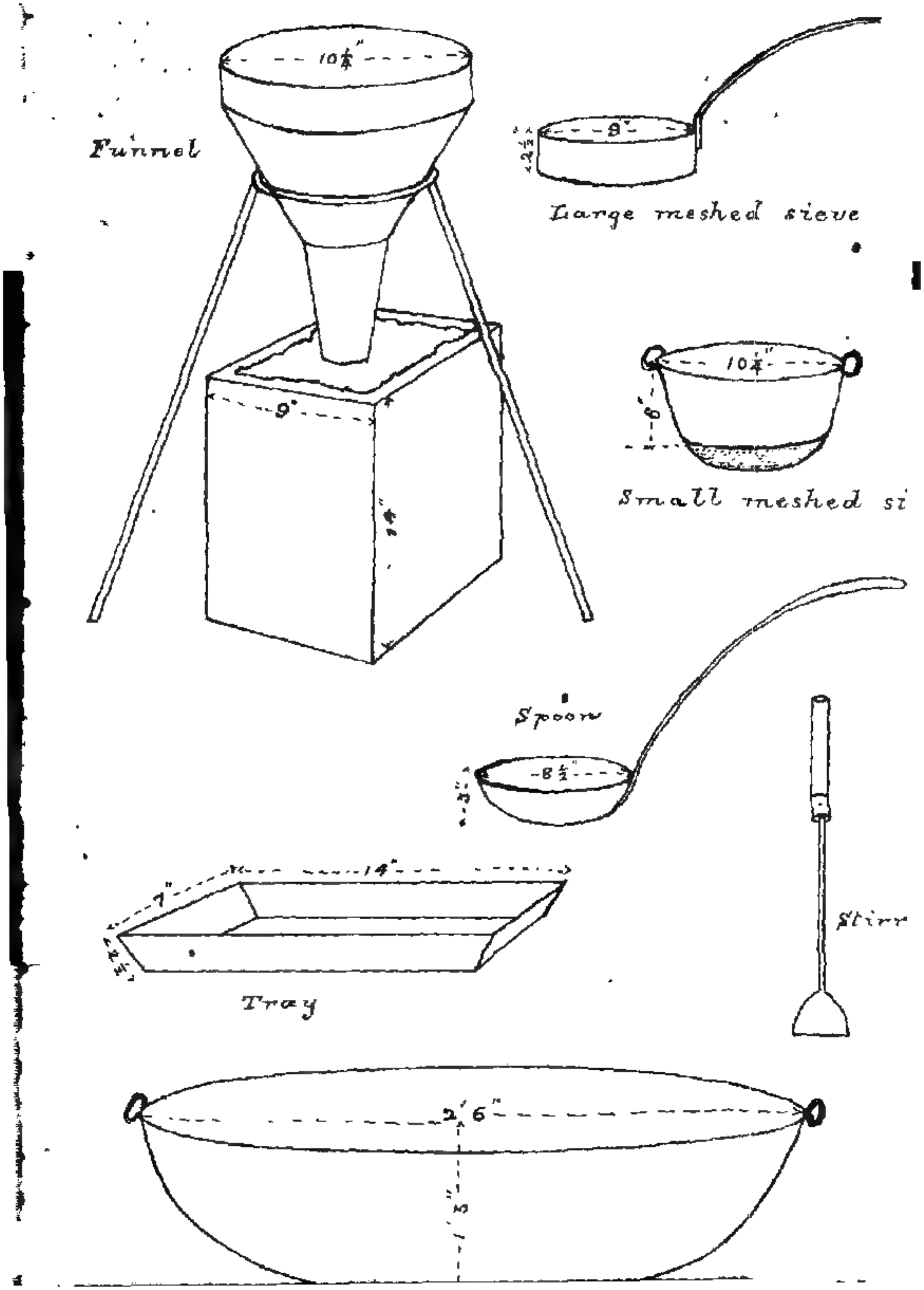
"The pots are now made locally of unglazed earthenware at a cost of Re.1-8-0 per 100. They were at first made of zinc, but these were soon abandoned, as they cost eight annas each, and were apt to be stolen by the hillmen

"The cut or blaze is freshened every eight days by taking off a shaving ¼ inch thick at the top, and about 8 or 9 inches long. In the chir pine the whole of the sapwood is capable of producing resin, but there are reasons for not making the cuts deep, one being that it would require a very long time for a deep cut to heal over. The trees are frequently 7 feet or more in girth, and two or three cuts are made on each such tree At the end of the working season, the cut is about 2 feet high, and at the beginning of the following season, the pot is removed to the top of the old blaze and the work continued as before. Some trees have been tapped, as an experiment, for the fourth and fifth year; but, generally speaking, three years is considered sufficient for one continuous tapping. The tree is then abandoned and allowed rest. To kill a tree, very heavy tapping is required. The timber of tapped trees is rather improved in quality than otherwise, though the blazes may sometimes interfere with cutting up to the best advantage.

"The pots are covered with pieces of chir bark to prevent foreign matter falling into them, but these are frequently blown off and much of the resin is mixed with pine needles, chips, bits of bark, etc., which have to be strained out afterwards.

"The resin is collected every eight days by a distinct set of men and taken to a depôt where it is strained through coarse and fine sieves and stored in wooden tanks. From time to time it is packed and soldered up in old kerosine oil tins, and then sent on mules to Chakrata on its way to Dehra, where it is distilled."

PLATE II



an inch, those of the latter one-sixteenth of an inch The coarse sieve is placed within the fine one and the whole is placed on a large tin funnel which rests on on a tripod stand, a tin being placed under the mouth of the funnel to receive the filtered resin, which is then ready to go into the still. An ordinary khurpi is used for stirring the heated resin in the caldron—an operation which is very necessary to prevent overheating and to accelerate the melting of the resin.

In connection with the filtering process, it may be mentioned that a temperature varying from 122° F. to 146° F. is found to be sufficient for all purposes.

The apparatus used for the distillation of the turpentine consists of three parts, each connected with the other. A boiler (*vide* Plate III), a condenser and a feeding tank for water. The boiler is connected with the condenser by means of a copper pipe, and the water is passed from the bottom of the water tank to the condenser along an open V shaped wooden gutter, lined with tin, leading into a pipe, which takes the water to the bottom of the condenser.

The Boilers.—There are three separate stills used at the School Factory; and, consequently, three boilers, varying only slightly one from the other The oldest copper boiler, obtained in 1890, is 3 feet 2 inches in diameter, 2 feet 1 inch in height; and its dome, together with the vertical portion of the copper tube, is 1 foot 9 inches in height. The length of the copper pipe is 13 feet 11 inches Its diameter is 2 inches. The thickness of the copper sheet of the boiler is three-sixteenth of an inch.

The dimensions of the two newer boilers, forming part of the other two apparati, are the same as those of the old one, except as regards the height of the dome and vertical length of the pipe, a very important matter. In the case of the two new apparati this height is 2 feet 1 inch, or 4 inches more than that of the old one. This extra height is a decided improvement, for it prevents the resin from boiling over and overflowing; and the apparatus, consequently, becomes less dangerous to use, and there is less risk of accidents.

The Condensers. These condensers have been purchased at different times from the Roorkee Canal Foundry. The one originally obtained in 1888 was of a very curious pattern which gave by no means satisfactory results and accidents followed. In this apparatus the vapour was first collected in a hollow drum before passing through a short length of worm placed inside a small water tank. The other two, procured in 1897, were, by some unaccountable mistake on the part of the manufacturers, complicated by the addition of a number of wholly unnecessary brass locks and other fittings and cost Rs.350 each. I then had one made in the bazar of the pattern shown in the sketch, which cost only Rs 27 and works in a perfectly efficient manner. It is made of galvanized iron and is 3 feet high and $1\frac{3}{4}$ feet

in diameter. The water-supply for condensing is stored in a galvanized iron tank on a raised masonry platform, 6 feet 3 inches high: the one tank which is 3 feet in height and $2\frac{1}{2}$ feet in diameter, and fitted with three taps at the bottom, being found sufficient to feed the three condensers.

From the condensers the water passes to two collecting water tanks; and as it cools it is again put into the feeding tank to be used over again. In this way much trouble and labour, which would otherwise be necessary in order to supply fresh water daily, is obviated. Once a week, however, fresh water must be supplied, as otherwise it would become foul. It should be added that water cannot be laid on, so the tank has to be filled by a bhistie.

The Charge.—After the crude resin has been filtered as above described, it is measured out in tins,* each having a capacity of 20 seers. Four tins of crude resin or 2 maunds together with two-thirds of a gallon of water constitute the charge for each of the boilers, which are filled overnight. Early in the morning heat is applied, the temperature of the resin soon rises from 50 to 180° C., and distillation commences. At first the proportion of oil to water in the product of distillation is as 5 is to 3; but as the distillation proceeds, the quantity of turpentine obtained decreases and that of water increases, until a proportion of 1 of turpentine to 7 of water is reached.

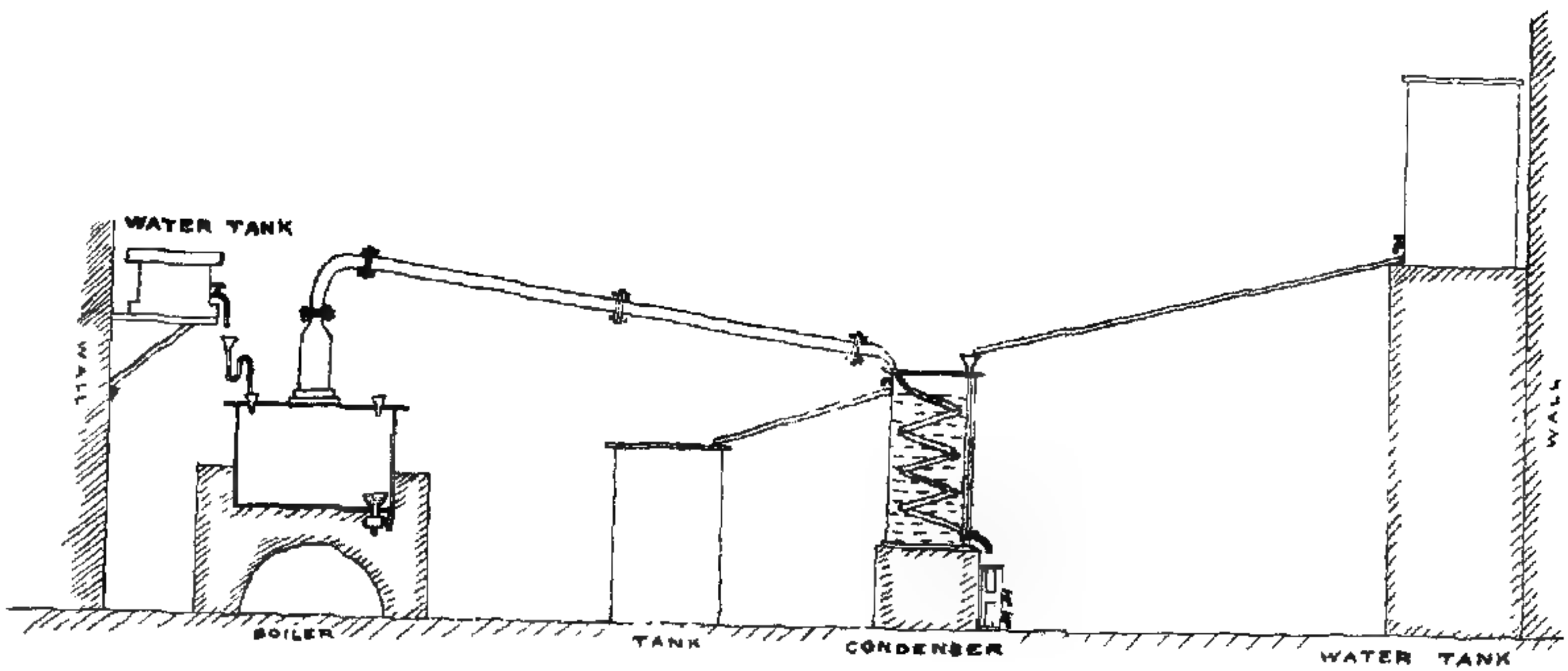
After about a gallon of turpentine has been distilled over and collected, water is very gradually added to the resin in the boiler, drop by drop; the water being led through a bent funnel from a reservoir situated immediately above each of the boilers.

Great care is necessary in heating the boiler at the beginning. Only moderate heat should be applied until the first six bottles of turpentine have been obtained. Overheating in the beginning will cause the resin to overflow and choke the condensing pipes, resulting in serious accidents. Within the space of eight hours from the time the distillation first commences, the whole quantity of turpentine is extracted, and only a small trace remains, which does not repay the labour and fuel required for its extraction. Moreover, continued heating only increases the colour of the colophony

To determine the proportion of water and oil in the products of distillation a graduated test tube is kept. When the ratio is found to be as 1 is to 7, the process is considered to be completed, the water passing by drops into the boiler is turned off and the residue is heated up for a few minutes before work is stopped. This precaution of turning off the water is extremely necessary. If it be neglected, water will be left in the colophony and cause it to become opaque On the other hand, if oil of turpentine is left in the colophony it will make it soft and sticky; either conditions lowering its value in the market.

* The ordinary kerosine tin is used for this purpose.

PLATE III



After the fires have been extinguished, the colophony is passed out through a tap, fixed in the bottom of the boiler, and collected in a receiving-pan resembling the caldron, figured in Plate II. A similar sieve is fixed to the top of the receiving-pan by means of clamps, and in order to increase its filtering powers a sheet of cloth is placed below the sieve. The resin must at first be let out of the boiler very gradually in order to avoid accidents, there being particular danger of its catching fire. The colophony is then poured out into dishes and pans and is allowed to cool and harden, when it is taken out and packed in gunny bags for the market. So much for the colophony. The turpentine as it distils over runs into a copper receiver fitted with two taps, one above and one below, and two panes of glass let into the sides (Plate III), so that the column of water and turpentine can be readily observed. The turpentine being lighter than the water floats on the top and can be drained off through the upper tap. As soon as the receiver is nearly full, the turpentine is drawn off into another vessel and the water allowed to run to waste through the lower tap. The turpentine is then shaken up for a few minutes with an equal quantity of fresh water and then emptied into another receiver of similar construction from which, after separation, it is drawn off into glass bottles. The object of the washing is to free the oil of any trace of acetic or pyroligneous acid. It has only been introduced lately, for reasons which will be explained later on.

The washed turpentine is allowed to stand in the bottles all night in order that any globules of water contained in it may sink to the bottom. The next morning it is filtered through ordinary filter paper, measured, and stored in galvanized iron drums. When filtering care is taken never to quite empty the bottles, the dregs which may contain minute quantities of water being collected in a separate bottle and allowed to stand till the water and oil have separated.

Through neglect of these precautions it has more than once happened that the turpentine, after being stored for some weeks, has become discoloured or even of a blood-red colour, the reason being that it has not been sufficiently cleared of water or acid or both. The acid corrodes the iron storing vessels producing ferric hydrate or ferric acetate.

Experiments were carried out by myself in 1899 to determine the best and most economical way of treating the turpentine when it has become discoloured. The following method gave successful results:—Two gallons of the discoloured oil with 12 gallons of water were poured into the still and gentle heat applied. The whole charge was distilled over in less than 3 hours, and only 4 gallons of water were left behind in the still. There was also a loss of about 12 ounces of turpentine to every gallon of discoloured oil put into the boiler. The turpentine thus obtained, however, was quite clear and free of acid.

Dr. H. Warth has also mentioned in his report that by the addition of sodium carbonate to the turpentine, the acid reaction of the same was neutralized: but sodium carbonate is far too expensive, and, consequently, it has not been given a trial.

The question of obtaining acetic acid as a by-product is receiving attention; but it is very doubtful whether it occurs in sufficient quantity to repay the cost of manufacture.

The resin supplied to the School Factory was originally obtained from *Pinus excelsa* and *Pinus longifolia* trees in about equal quantities; but latterly only *Pinus longifolia* resin has been collected, which appears to contain a larger percentage of acetic acid than that from *Pinus excelsa*. Hence it has been found necessary to introduce the washing process, which was not required when the two resins were distilled together.

The Yield.—From every 2 maunds of crude resin placed into the still, 3 gallons of turpentine and about one and a half maunds of colophony are obtained. The yield of oil from *Pinus excelsa* resin is very much greater than that obtained from *Pinus longifolia*, the proportion being as 11 to 9. The specific gravity of the former also is 0·866 as compared with 0·870, the specific gravity of the latter; so that the oil obtained from *Pinus excelsa* is both superior in quality and greater in quantity.

Turning now to the colophony, a different result is obtained. The colophony from *Pinus excelsa* is of a greenish yellow colour, while that obtained from *Pinus longifolia* is a pale amber, and consequently superior in quality. The colour of the colophony, however, depends to a great extent on the impurities that may get mixed up with the resin after its extraction from the tree. If these happen to be soluble, and will pass through the narrow meshes of the sieve, used in the filtering process, the colour will be affected; otherwise it will not. Hence the necessity, as explained above, of using a cloth below the sieve of the colophony receiving-pan.

Moreover, the first portion of colophony collected from the boiler must be rejected or kept separate.

Financial Results.—The following is the result of operations from 1890-1 to 1899-1900 inclusive:—

EXPENDITURE.			Rs.
Total expenditure on all accounts except supervision ...			46,886
Deduct estimated present value of tools and plant ...			3,900
			42,986
RECEIPTS.		Rs.	
1,292 maunds crude resin sold for ...		6,737	
Sales of turpentine and colophony ...		43,100	
Value of resin, etc., in stock, on 20th June 1900, *viz*:—			
708 maunds resins ...	Rs. 3,540		
20 do. colophony ...	„ 145		
68 gallons turpentine ...	„ 136	3,821	53,658
Surplus	...	...	10,672

The *total amount* of crude resin distilled during the ten years was 5,971 maunds, yielding 4,494 maunds colophony and 9,978 gallons turpentine.

In conclusion, it may be interesting to refer briefly to some of the accidents that occurred when operations were first started at the Forest School. The first accident was due to gross carelessness on the part of the man in charge of the boilers. He was heating the resin in the still very irregularly—now too high, now too low, and similarly the water was being added very irregularly. At one time the boiler was left without any water being added, at another time after its discontinuance it would be added in large quantities, so that the oil would be forced out in jerks. In the end, as a result of this, the safety cork was forced out, the resin and oil flowed out and the whole was set on fire. This happened on two occasions, and a good deal of damage was done before the fire could be extinguished.

Another accident occurred in 1895. The colophony, when being let out of the still, caught fire in the large receiving-pan. Unfortunately a visitor, who happened to be present at the time, made matters worse by throwing water on the burning colophony, and thus causing the fire to spread. Eventually, however, the fire was extinguished by earth and mud being thrown on to it; the colophony, however, was utterly spoilt. This fire was attributed to the colophony having been heated up too long after the addition of water had been discontinued; so that a vast quantity of white fumes were formed, which took fire either by their communicating through a crevice with the fire underneath the boiler, or with a spark from a cigar.

The result of distilling with an insufficient quantity of water clearly shows itself in the colour of the turpentine and colophony obtained. When the resin is heated to a high temperature with an insufficient quantity of water it is burnt and turns to a dark colour. Moreover, a good deal more acetic acid is left in the oil, and this corrodes to some extent the vessels in which the turpentine is placed, and, as we have already seen, causes it to be discoloured. On the other hand, when distillation is conducted with a sufficient quantity of water, these defects do not appear, and light-coloured colophony and clear oil of turpentine are obtained.

DEHRA DUN, N.-W. P.

BIRBAL,
Asst. Instructor, Imperial Forest School.

Effects of the late Drought in the Chanda District.

In *The Forester* for July, I see mention has been made regarding the effects of the late drought in the Central Provinces' forests. I would supplement that article with a few *notes from this* district. The years 1899 and 1900 will be

remembered by all the inhabitants of the district, both big and small, as being ones of not only an unprecedented famine, but also of drought. The normal yearly rainfall of the district is 45 inches; so that when the rains of 1899 began it was expected that the year, like its predecessors, would be a normal one, instead of which July went by and no rain: well into August and still no rain; about the latter end of the month we had close on 11 inches and there looked a chance as if things were brightening up; but, alas! September went by worse off for rain than even the previous two months. Most of the crops had withered, and the outturn, should rain have fallen even then, would have been close on two annas in the rupee. The expected rain never came, and all sowings were a complete failure. This was serious enough, but when combined with the fact that not a drop of water had come into the tanks and that the wells were at their lowest hot-weather level, the situation was most serious. Things went from bad to worse, the tanks dried up fast and the wells sunk lower and lower. By the end of December some of the finest tanks in the district had dried up and most of the wells in the villages instead of being full up, had water barely sufficient for the day's requirements of the villagers. This want had become so serious that the matter of locating the relief camps was one of great consideration. Wells were dug in the beds of favourable streams both for man and beast, yet even this was not sufficient for the cattle, and it was no use giving them water where fodder was not obtainable; so that with a small exception, the whole of the forests in the district were thrown open to grazing; but then, here again, we had to select sites where water was obtainable for locating the large herds that came into the forests. Cattle not only of this district but from other districts of the province and from the Berars. Since matters had reached such a critical point, it is hardly to be wondered at that this great and abnormal change in the season had an effect on the forests of the district. The grass which in any ordinary year is fairly luxuriant all over the districts where the grazing is not heavy, failed to rise above a few inches in most places, and only in exceptional places was it over a foot or two and fit to be cut. The seeding of the grass also was very bad for want of moisture, and this has been most strikingly illustrated during the present rains, which have been very heavy, and above the average. The long stretch of hot weather combined with the drought has no doubt helped to kill even the roots of the old grass stems in most cases. I notice this most strikingly in some of the forests, and also in my own compound, a very large one, where the common spear grass used to flourish in regular stretches. I have lately gone over these areas most carefully, and see not a trace of the grass. Small weeds have sprung up instead, which is due to the seeds of these species having been able to withstand the heat and drought better than grass seed, most probably the greater part of what has sprung up is what fell after the rains of 1898, for there

was little or nothing to be seen last year. Going further, the entire change in the season altered the season of flowering of a number of forest trees. While touring in the north of the district in November last, I noticed that a number of a "mohwa" trees were in flower, which is quite unusual; the flowers coming late in February in any ordinary year. Then again a month later numbers of "paras" (*Butea frondosa*) were far advanced in flower. But what was most striking was the "bamboo" (*Dendrocalamus strictus*). This evidently flowered early in October in various localities of the forest, as it was shedding ripe seed in December. In one locality of the district especially, where the bamboo had gregariously flowered over a large area of forest, the seed was being greedily picked daily by thousands of people from the district. This area is situated on the Wardha, about 10 miles above its junction with the Wainganga river. The bamboo for miles round on both banks of the river was seeding, quite an abnormal state of affairs, and all due to the excessive drought. I do not think I am far wrong when I say that this bamboo seed helped to keep alive over thirty five thousand people at a most trying time; this lasted from January to about the middle of April. When touring in these parts in March, I met hundreds of people on the move in the one direction, and their one answer was "*kattang*," by which they meant that they were going to pick bamboo seed. It was while passing through this area that I noticed that all the culms in the clumps were streaked all down with what appeared to me to be a white brittle gum similar to what one sees exuding from the *Odina wodier*. I at once collected some, and, on tasting it, found that it was very sweet. This sugary deposit only extended for about 5 feet along the culms and was entirely absent towards the tops. It was found both at the nodes, as well as on the stems between the nodes. I am sure that this has nothing to do with any insect deposit, nor has it been caused through the aid of insect punctures in the bamboo, as I made a careful examination of a number of culms. The culms also were old ones. The men with me, all local Gonds, and all those in the neighbouring villages, had never seen the like before; and I am sure that had this exudation occurred within recent years in the forests, they would have known of it. As this exudation from the bamboo has already been touched on in *The Forester*,* I will go on to a more important result of the drought, and that is, the year's mohwa crop, which is a great mainstay of the district, and which, had the crop been good, would have taken thousands off the relief camps for at least a couple of months. I have already mentioned the flowering of some of the mohwa trees in November, but this was only a drop in the ocean compared with the yearly mohwa flower crop. The mohwa flowered and most sanguine were the hopes, and from every quarter I was told that there would be at least a half crop for the year, and on one occasion when

* Vide *Indian Forester*, Vol. XXVI., No. 7, page 336.—HON. ED.

I happened to make a remark that if the district had a two-pice crop in the rupee it would be lucky, I was jeered at. This unfortunately came only to be too true, and the crop may be said to have been a complete failure. Before making the above statement I had noticed while going through the forests, that though the flower buds had come out thickly on the trees, the drought had dried up the corolla on the flower stalk before it had time to develop and fall. Seeing the flower buds, no doubt, led to the idea that it was going to be a fair mohwa year.

I now come to the damage done to trees through the continued drought. This has not been anything very noticeable. Now that the rains are on, the trees in the forest all seem alive. The small damage is due to the trees having shed their leaves months sooner than they otherwise would have done, and thus being able to do with the very smallest amount of moisture possible from the soil. On the other hand, such evergreen trees as mangoes, *Polyalthia*, of which there are a few, and the palms (*Phoenix* and *Borasus*) suffered very severely. Many fine mango trees were killed outright and but few escaped damage, their top branches being killed in most cases. Of the palms, some like the *Borasus* were killed outright, while nearly all had their leaves turned yellow. I must note, however, that the rapidity with which these palms have recovered themselves during the present rains is marvellous.

CHANDA,
Central Provinces.

A. G. LOWRIE.

The Forests of Java and their Management.

(Continued from page 456.)

As has been noted above, the exceptionally high value of teak for almost all purposes makes it of great importance as an article of trade. This together with the fact that the species in Java extends over an area of not less than 655,000 hectares, mostly in the form of unmixed woods, has caused special attention to be paid to the forests from a very early date. The following will therefore deal mainly with the teak tree, especially as regards the early history of the forests, their working plans, utilization, cultivation, and treatment.

The teak tree flowers every year at the beginning of the rains, the first buds generally showing above the crowns in October or November. The flowering continues up to May, but is at its height in January and February. The tree has therefore every chance of producing an abundance of seed and a failure of the crop is unknown. The fruits ripen in July and August and germinate early in the next rainy season. Seed required for sowing is usually collected in

August. It should be noticed that teak produces fertile seed at a very early age, trees grown in the open and coppice shoots at from 6 to 12 years of age and in closed forests at from 12 to 20 years. If left to nature the young plants attain a height of 0·25 metres during the first year and under ordinarily favourable circumstances are 1 metre high at the end of the second year; but by deep cultivation of the soil the rate of growth can be increased up to 1 metre during the first year and 5 to 6 metres by the end of the second year. When 10 years old the tree is generally over 12 metres high; towards the 20th year the rate of growth in height begins to fall off and the diameter growth to increase in proportion. As a rule, a mature teak tree varies in height from 20 to 40 metres and in diameter from 30 to 120 centimetres, according to the situation and degree of density of canopy. In forests, with a closed canopy, the tree has a long bole and dome-shaped crown. In the open it bears a low irregular much-branched crown. The stems are buttressed up to a height of about 3 to 4 metres; on good situations, with complete canopy, they are more or less regular and cylindrical, though often fluted or excentrically grown. The tree is, however, capable of producing very irregular stems, in fact the strictly regular form is scarce.

It is characteristic of the tree that it loses most of its leaves during the dry season, the time and degree of fall varying with the dampness of the soil and other factors. The young foliage appears in October, coming out slowly at first and not in full flush until after the first rains have fallen.

When the tree has reached the pole stage, the tap-root gradually dies off from the point upwards, and the tree then depends on its side roots for nourishment. The root system adapts itself to circumstances, being very shallow on good fresh soils in sheltered situations, and striking deep on poor soils or in exposed localities The tree is thus able to maintain itself even in the limestone hills, where the rock is covered only by a thin layer of soil.

Teak differs from most tropical trees in forming distinct annual rings Silicic acid occurs in the outer bast layer and amorphous lime is found in all parts of the stem varying from fine hair-like lines to masses completely filling hollows as large as one's fist. Deposits of lime of this size greatly detract from the value of the timber, as in such cases it cannot be used for beams, and there is great waste in cutting it up for other purposes. The lime found in the wood is in no way dependent on that in the soil as has sometimes been supposed, the deposits being more frequently found in trees grown on deep, rich, damp soils comparatively poor in lime but of great fertility, which produce timber with broad annual rings and soft porous wood. It is to some extent influenced by the age of the tree, as the larger deposits are only found in the heart wood of trees over 50 years old. It is, therefore, a matter for consideration whether it would not be

advisable on such soils either to shorten the rotation or to substitute some other species worth cultivating.

The teak tree attains an age of 200 years and more, and produces mature marketable timber at from 80 years upwards, according to situation and other circumstances.

It is a gregarious, emphatically light demanding tree which, however, when young, can withstand for several decades the shade of light-crowned trees as well as that of its own species, provided the latter are not too closely grown and have reached middle age. In younger woods, even when heavily thinned, the shade from the low crowns and stool shoots is too dense to allow seedlings to come up. It grows only up to about 500 metres above sea-level, as it is not suited to the excessively moist climate of the hills, and is there crowded out by a rank growth of other trees and shrubs.

It should be noted that in teak forests, with a closed canopy, the ground-cover of shrubs and herbage is for the tropics comparatively scanty, which is explained by the fact that only those plants can establish themselves which are capable of enduring the dense shade of the teak trees during the rains and the sudden cessation of shade that takes place when the leaves fall. Moreover, in most forests, the seeds and surface roots of the undergrowth are regularly destroyed by annual fires, so that during the east monsoon the ground has the appearance of having been swept, and remains quite bare until the west monsoon sets in.

The teak tree is most abundantly distributed over the central and eastern parts of Java. In the mountainous country on the west conditions are not favourable for its growth. It prefers the region of undulating hills and plains, avoiding, however, wet localities, such as low lying coast tracts and banks of rivers, as well as rich alluvial soils which are monopolized by other species. That it is not very particular in respect of soil is evident from its occurrence gregariously over large areas, but it grows best on not too shallow soils possessing some degree of tenacity, such as those derived from marine formations, more especially limestone, marl and calcareous loam or sand. Timber grown on such soils is hard and strong with annual rings of equal width. Teak also occurs on clayey soils in this region, but it falls off in growth as the proportion of lime and sand in the soil diminishes and on really stiff clay only lingers out a miserable existence. This is also the case on strongly-cemented sands, the so-called *padas*, which are often found occupying the ridges. Sandy soils of volcanic origin are equally unfavourable to the growth of teak, but, on the other hand, the tree is quite at home on the yellow, red or brown-coloured volcanic loams and clays, though here accompanied by other trees to a much greater extent than on tertiary soils.

Tradition says that teak forests existed in Java long before the country was inhabited; but the question as to where the original home of the tree is to be sought, has hitherto remained an open one. Even if the cradle of the cosmopolitan species of animals and

plants found in the western Malay Islands be referred to Continental India, on the assumption that these islands were at one time not separated by the sea, and that at that time there was consequently no hindrance to the natural extension of these species, the theory, in so far as it concerns the teak tree, is open to objection, because the spread of the tree from north to south would be stopped by the zone of evergreen species with uninterrupted vegetative activity situated in the immediate vicinity of the equator, in which to this day no naturally-produced teak forests have ever been found. (*Cordes, de djatibosschen op Java*, p. 115.)

It may, therefore, be assumed that the teak tree found in Java conditions quite as suitable to its organic life and individuality as those existing on the coast of Malabar, in Pegu, in North Siam and in Cochin China, which, here as there, favoured in the first place its origination, and later its dissemination abroad.

It is quite certain that in Java the latter resulted in widespread forests, the extension of which received its first check with the advent of man in the habitable regions on the north coast and in the plains through which the larger rivers flow. Later, as the nomadic life of the people gave place to a more settled existence, and the idea of States under the rule of Chiefs developed itself and gave rise to the foundation of cities, the bounds of the forest became still further restricted.

Of still greater importance was the introduction of rice into Java by Buddhist and Brahmin colonists, and the gradual development of sea-borne trade and fisheries by which the area of cultivation was increased at the cost of the forests, while at the same time heavy demands were made on the latter for the supply of teak timber.

When the Dutch East India Trading Company took possession of the Island, the forests were still more heavily worked. The building of dwellings, warehouses, wharfs and ships necessitated the use of enormous quantities of timber, which the native Chiefs were obliged to supply. The latter entrusted the felling and dragging out of the timber to their serfs, and as the work was carried on without any supervision whatever, an unexampled state of devastation was soon brought about. Forebodings as to a possible dearth of timber seem to have been entertained so far back as the latter half of the previous century; but they were entirely disregarded, and it was not until quite the end of the century, when the teak forests, together with the colonies, came into the possession of the Dutch Government, that measures were taken for their management and protection. It was then proclaimed by Marshall Daendels, that the trade in teak timber was the sole monopoly of the State, and that it was the duty of the native population to deliver whatever timber was required ready prepared for the market. Any possible advantages thereby gained were lost during the temporary occupation of the

Island by the English, and although the Dutch, when they again obtained possession, passed in 1829 *an ordinance* for the protection of the forests, it was without result, because from motives of economy the protection and management of the forests was entrusted to the political authorities and the establishment provided was inadequate for the enforcement of the rules. In addition to this considerable areas of forest were devastated for the construction of fortifications during the Javan wars of 1825 to 1830; and later, when the notorious system of cultivation introduced by the Governor-General van den Bosch came into force, not only was no further interest taken in the forests, but they were plundered to a greater extent than ever. The forests in the north of the Island had been badly devastated in the earlier days, and now those in the interior were attacked to supply timber for the construction of a mushroom growth of sugar, indigo and tobacco factories, and for the supply of fuel, the destruction of the forests which had hitherto escaped being rendered more easy by the construction of roads and by the utilization of streams for export.

Finally, when the sources of supply threatened to dry up, the felling of timber by natives and private persons who had settled in the country was prohibited by a series of laws and regulations; but these did not affect the Government itself which was the chief agent in the wasteful treatment of the forests. The Navy, the Engineers, the Artillery, the Public Works and all branches of the civil administration demanded certain qualities and dimensions of timber which could seldom be obtained in sufficient quantities from clear fellings, so that a rough method of selection felling had to be adopted. If the timber when felled was not exactly what was required, or if there was any difficulty in removing it, it was left lying in the forest and not infrequently heavy logs were adzed down to furnish pieces of small dimensions. When it is further considered that not only the felling, conversion and export of the timber, but also the regeneration of the areas clear felled was carried out under the supervision of dishonest subordinates by a population heavily oppressed by the burden of forced labour, and that the officials entrusted with the higher administration made many times the amount of their salaries out of the timber disposed of, it is easy to understand that timber became more and more difficult to obtain.

The Government, therefore, felt itself constrained to enter into contracts with specially-favoured private persons to whom blocks of 25 square kilometres or more were leased on the condition that a portion of the timber should be delivered to Government. This, however, only helped the State, and private persons were still unable to purchase timber except at exorbitant prices. A system of auction sales was therefore adopted in many districts, the surplus timber from the clear fellings not required by Government being brought to depôts and sold to the highest bidder. Dead and windfall trees lying in the forest were also disposed of in the same manner.

But none of these measures were of any benefit to the forests and extensive blanks and wildernesses, areas of failed and abandoned sowings and plantings, with thousands of tons of rotting timber lying in the forest—all bore witness to the unexampled state of devastation brought about during the century.

A change for the better could only be achieved by abandoning the old parsimonious system of working and by employing free paid workmen under technically-trained Forest officers in place of forced labour. This radical reform was introduced by the law of the 10th September 1865 for the better control and working of the forests of Java and Madura. Under this law the forests were divided into two classes, one to be placed under a regular system of management, and the other to be worked without any system whatever. In the former, exploitation was to take place by regular clear fellings proportionate to the annual increment, the felling conversion and disposal of the timber being leased by tender to contractors instead of being carried out by the State. Under this system the standing trees on blocks of several hundred hectares was made over to the highest bidder, who was either allowed to dispose of the timber as he pleased, or in some cases was obliged to deliver it to the Government at a fixed rate of payment. The remaining forests for which no regular plans were prescribed, were set apart for the use of the natives and immigrants, and for the supply of timber for any local public works.

The forests might now be expected to be in a fair way of being properly regulated, but in certain respects the new rules had the opposite effect to what was intended. The price of the timber owing to the previously existing monopoly had risen enormously high, and in order to maintain it at this level a smaller number of blocks was leased than was sufficient to meet the actual demand. The consequence of this was that the general dearth of timber led to an enormous increase in the number of thefts, which the forest and police establishment were quite unable to check, especially as the extremely insufficient sentences passed afforded them no support.

For these reasons Government, in 1874, repealed the law of 1865 and replaced it by a new Act, which ensured the permanent maintenance of the forests and formed the foundation of the existing methods of management.

From the above remarks on the history of the teak forests some idea can be formed of their present condition. In places where clear fellings had been made in the previously heavily-worked forests, extensive areas of alang-alang grass have sprung up, or thorny thickets of lantana scrub. Where teak was mixed with other species it has been suppressed by the latter, and in forests which have been worked more lightly either by group or selection fellings, the only reproduction has been in the form of worthless stool shoots. The more accessible forests are almost without exception in this condition, and along the northern coast and in the immediate

neighbourhood of towns, cultivation, roads or rivers, many blocks of teak forest, thousands of hectares in extent, have disappeared altogether.

The destruction of teak forests by native cultivation went on unchecked, until the law of 1874 was enforced. The traces of this can be found deep in the forests, especially in the numerous valleys, which could be irrigated and which contained land suitable for cultivation. In such places the trees were killed by girdling and the land planted with rice or Indian-corn.

Although an immense reduction has taken place in the area of the forests, nature is constantly endeavouring to re-clothe the tracts temporarily devastated. It is true that the natural formation of woods progresses but slowly, and, owing to the weight of the seed, only from the edges of existing woods, but nevertheless a reference to the older maps shows that wherever efficient protection has been afforded, a perceptible increase has taken place in the areas stocked with teak.

(*To be continued.*)

III.—OFFICIAL PAPERS AND INTELLIGENCE.

Tannin Extracts from Pterocarpus Marsupium.

Circular letter addressed to all Conservators of Forests by the Inspector-General of Forests to the Government of India.

SIMLA, *the 12th September* 1900.

SIR,

I HAVE the honour to say that I have had under consideration the question of the possibility and advisability of placing on the market, as a tanning agent, tannin extracted from *Pterocarpus marsupium*, and beg to communicate the following remarks on the subject.

2. In Coorg, where experiments have been made with the bark of this tree, 15 quarts of water were added to 10 lbs. of the bark. This was boiled in earthen chatties over a slow fire for six hours, and the extract thus obtained was then boiled down to a sticky consistency. This substance was found to contain 37·77 per cent. of tannin, while the dry extract prepared from it by Mr. D. Hooper, Curator, Economic and Art Section, Indian Museum, Calcutta, yielded 90·6 per cent. of tannin. A chemically dry extract like that prepared by Mr. Hooper could probably not be manufactured on a large scale for commercial purposes, nor would this seem to be necessary. If, however, proper appliances were used, including vacuum condensers, and an extract containing 80 per cent. of tannin could be manufactured—and I have no doubt this could be done—it would be possible to place an unlimited

quantity of the extract on the market at £25 per ton. This is a matter which should not be lost sight of and which might well receive consideration by all officers in whose circles *Pterocarpus marsupium* is common. *It should, however, be borne in mind* that without a vacuum evaporator it would be futile to attempt competition with tannin extracts prepared according to the latest European methods. Moreover, there is no reason why experiments for the extraction of tannin should be confined to *Pterocarpus marsupium*. The list circulated with my letters Nos. 122 to 137 of the 5th February 1898, and published in the article on Tannin Extracts in the *Indian Forester* for April 1899, indicates the species that may be taken into consideration.

3. The Government of India have decided to import a modern apparatus for the preparation of *tannin extracts, the results* of the working of which will be published in due course. In the meantime all that is necessary is that Conservators should select areas suitable for the exploitation of tannin extracts; but this is a task that will need to be approached cautiously, inasmuch as a considerable annual possibility of bark, etc., will be required to warrant the setting up of a tannin-extract manufactory. It may take several years before a decision as regards areas suitable in every respect can be arrived at, and it is, therefore, advisable that the question should be fully considered at an early date. It is quite possible that it may be found that a central condensing factory might be fed with liquid extracts prepared in the jungle, in preference to barks and woods being carried thereto, and that the circle of operations which can be served by one factory is thereby widened. So long as no iron pans are used in the preparation of preliminary boiling down of such extracts, this would be unobjectionable.

4. I append, for information, a copy of a report* by Professor W. R. Dunstan, F.R.S., Director of the Scientific Department, Imperial Institute, on a sample of kino from *Pterocarpus marsupium* grown in the Chanda Division, Central Provinces. It is evident that so long as kino is prepared in its present manner, it can only be profitably supplied if paid for as a drug, and not as a tannin extract only. The market for it as a drug is very limited and prices can be easily depressed by the least overstocking.

* Dated 8th December 1899.

I have the honour to be,

SIR,

Your most obedient servant,

B. RIBBENTROP,

Inspector General of Forests.

Report by Professor W R. DUNSTAN, *F.R.S., Director of the Scientific Department, Imperial Institute, on a sample of Kino from the Chanda Division, Central Provinces.*

This sample of kino, from *Pterocarpus marsupium* grown in the Chanda Division, Central Provinces, is that referred to in Dr. Watt's letter F.S. No. 3039 -43, dated 17th November 1898. In order to compare this sample of kino with the kino derived from the Malabar forest in Madras, a chemical analysis of it has been made with the following results: –

	Per cent.
Moisture	16·23
Substances insoluble in water	10·28
Tannin (absorbed by hide power)	84 69

From these results it is clear that the Chanda kino has very much the same composition as that from Malabar.

Although the kino answers all the tests of the *British Pharmacopœia*, it is very inferior to the best kino in appearance. The fragments are smaller, duller, and darker in colour, which will probably detract from the commercial value. It is probable that these defects are due chiefly, if not entirely to careless preparation, especially from overheating in drying the material.

I have already discussed the commercial position of kino in a previous report, dated 14th June 1898, and it still commands a high price in the English market. It would, therefore, seem to be worth while to submit for examination another sample of Chanda kino more carefully prepared.

I may add that a commercial expert, whom I consulted on the general question of kino, suggested that it would be more profitable to the producers if Indian kino of uniform quality were sent to England and consigned to one drug-broker only. If this were done, it is stated that a better price would be obtained for the material It is thought that so long as indiscriminate shipments are made by any one, and forwarded to various brokers in this country, the price of kino will fluctuate very greatly, and may on some occasions fall as low as 37*s.* 6*d* per hundredweight.

WYNDHAM R. DUNSTAN,

Director, Scientific Department.

8th December 1899.

Comparative Strength of Ceylon and European Timbers.

Office of the Conservator of Forests,
Colombo, 24*th July* 1900.

Sir,

In continuation of my letter (and annexures) published in the October Number of *Indian Forester*, 1899 (Vol. XXV., No. 10, pp.

410—415), I have the honour to forward copy of a further report by Professor Unwin on the comparative strength of the timbers referred to with that of European timbers.*

2. For easy reference I again append a list of the botanical names of the trees referred to.

I am, Sir,
Your obedient servant,
A. F. BROUN,
Conservator of Forests.

HONY. EDITOR,
"*Indian Forester*."

List of botanical names referred to.

1.	Sapu	... ...	*Michelia Champaca.*
2.	Panakka	.. .	*Pleurostylia Wightii.*
3.	Gurukina	. ..	*Calophyllum Burmanni.*
4.	Vinnanku	.. ...	*Pterospermum suberifolium.*
5.	Satinwood	.. ..	*Chloroxylon Swietenia.*
6.	Milla	... ...	*Vitex altissima.*
7.	Illanthai	.. ...	*Zizyphus Jujuba.*
8.	Mendora	... .	*Vatica Roxburghiana.*
9.	Ubberiya	.. ...	*Carallia calycina.*
10.	Tawenna	... ...	*Palaquiuum petiolare.*
11.	Dawata	... ...	*Carallia integerrima.*
12.	Margosa	... ...	*Azadirachta indica.*
13.	Lunumidella ..	...	*Melia dubia.*
14.	Walukina	. ...	*Calophyllum bracteatum.*
15.	Ranai	... ...	*Alseodaphne semecarpifolia.*
16.	Chorunntiri	...	*Heritiera littoralis.*
17.	Suriya	... ...	*Thespesia populnea.*
18.	Jak	... ...	*Artocarpus integrifolia.*
19.	Del	... ..	*Do. nobilis.*
20.	Halmilla	.. ..	*Berrya Ammonilla.*
21.	Suriya Mara ...	...	*Albizzia odoratissima.*
22.	Nedun	... .	*Pericopsis Mooniana.*

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* *Vide* also *Indian Forester*, Vol. XXVI, No. 7 of 1900, page 312. HON. ED.

NOTE.—Numbers 1, 2, 3, 6, 8, 9, 10, 11, 13, 14, 17, 19, 20, 21, and 22, are Sinhalese names, Numbers 4, 7, 15 are Tamil, and 5, 12 and 18 English names.

Comparison of the Strength of Ceylon Timbers with that of European Timbers.

By Professor W. C. Unwin, *F.R.S., &c., Scientific Referee of the Imperial Institute.*

The precise combination of qualities required in a timber for special purposes including facility of working, uniformity of structure and freedom from defects, appearance, durability and other qualities, is not to be determined from mechanical tests alone. Further, the results of mechanical tests of the same timber vary with the locality in which the timber is grown, the conditions of felling and seasoning and other circumstances to a greater extent than is commonly supposed. In some 2,000 tests of different logs of long-leaf pine made for the Government of the United States which had all been selected by the Forest Officers and subjected to the same treatment, it was found that the crushing strength varied from 2·04 to 4·40 tons per square inch; the coefficient of transverse strength from 1·90 to 7·2 tons per square inch; and the heaviness from 28 to 65 pounds per cubic foot. Hence very definite deductions from any set of tests on a limited number of logs must be accepted as subject to correction.

For European timbers, I take the following values as representing fairly what is accepted as the average of such results as are most trustworthy:—

European Timbers.

Name of Timber.	Heaviness in pounds per cubic foot.	Crushing strength pounds per square inch	Transverse strength pounds per square inch.	$\frac{Fc}{W}$	$\frac{Fb}{W}$
	W.	Fc.	Fb.		
Oak	52	10,000	12,000	193	230
Elm	34	10,300	8,000	320	235
Ash	47	9,000	13,000	191	277
Red Pine ...	37	5,800	8,300	157	224

Broadly speaking, the strength of timber increases with its heaviness. The most valuable timber for structural purposes are those which have considerable strength without excessive heaviness. The pine timber so largely used are not only easy to work, but they have good strength in proportion to their heaviness. In the above table the strengths have been divided by the weights per cubic foot, and the results are given in the last two columns. Compared in this way elm is superior to oak, and even red pine is not much inferior.

Table of Ceylon Timbers.

Strength of Timber.	Heaviness in pounds per cubic foot.	Crushing strength pounds per square inch.	Transverse strength pounds per square inch.	Fc. / W.	Fb. / W.
Light Timber under 42lbs. per cubic feet	W.	Fc.	Fb.	W.	W.
Sapu	41·4	3,490	7,820	84	188
Vinnanku	40·4	4,290	9,510	106	234
Lunumidella	26·4	3,200	5,7[illegible]0	157	290
Walukina	32·4	6,100	9,010	188	2[illegible]0
Medium Timber, 42 to 60lbs. per cubic feet.					
Panakka	54·9	9,[illegible]00	12,981	167	236
Dawata ...	47·3	5,920	10,820	125	2[illegible]8
Jak	43·4	7,550	6,840	174	1[illegible]7
Del	48·1	6,[illegible]00	9,310	156	193
Suriya Mara	57·0	9,300	14,600	163	256
Illenthai	48·9	6,170	7,[illegible]90	126	159
Mendora	59·7	5,810	13,710	98	230
Ubberiya	50·7	7,620	10,090	139	178
Tawenna	46·1	7,660	8,0[illegible]0	166	175
Margosa	47·3	6,640	11,480	140	244
Halmilla	49·9	7,630	15,[illegible]60	153	310
Suriya	50·3	6,2[illegible]0	11,660	124	233
Heavy Timber over 60lbs. per cubic feet.					
Gurukina	62·6	5,350	8,740	86	140
Satinwood	64·3	7,500	13,780	116	214
Millai	60·9	6,630	14,760	109	242
Ranai	63·3	5,800	10,579	92	167
Chonumtiri	75·5	6,530	14,490	85	192
Nedun	70·8	8,700	16,040	125	226

Taking the light wood, it is clear that as regards strength in proportion to weight Lunumidella and Walukina stand best. The remarkably light wood Lunumidella is not absolutely as strong as red pine, but in proportion to its weight it is even a better timber. Walukina is weaker than Ash and about the same strength as red pine.

Of the medium woods Halmilla is strongest in proportion to its weight and Suriya Mara stands next. Ubberiya, which Mr. Stone thinks well of, is somewhat weaker than oak, but it has a greater transverse strength than elm. Tawenna has nearly the same mechanical properties as Ubberiya. Suriya Mara is somewhat stronger than either of these.

The heavy timbers do not give very high results. Satinwood has greater transverse strength than oak, but the strength in

proportion to weight is not so good. Millai and Chonumtiri have a little greater transverse strength, but their crushing resistance is low. Nedun is the heaviest and for cross breaking the strongest timber; but its constants obtained by dividing the strength by the weight are not so good as those of European timbers.

I know no tests of the shearing resistance of European timbers along the fibres which are trustworthy, but the following results of tests at Watertown Arsenal may be used for comparison with the tests of Ceylon timbers:—

Shearing Strength pounds per square inch.

Ash	458 to 700
Red Oak	726 " 999
Yellow Pine	286 " 415
Spruce	253 " 374

Shearing Strength of Ceylon Timbers.

Name.	Shearing strength along fibres pounds per square inch.	$\frac{Fs.}{W.}$
	Fs.	W.
Light Timbers—		
Sapu	753	18
Lunumidella	478	23
Walukina	337	10
Vananku	486	12
Medium Timbers—		
Panakka	745	14
Dawata	1,075	12
Jak	672	15
Del	1,236	24
Suriya Mara	1,283	22
Ilanthai	1,019	20
Mendora	620	10
Ubberiya	1,066	18
Tawenna	1,084	23
Margosa	1,326	28
Halmilla	830	18
Suriya	927	18
Heavy Timbers—		
Gurukina	948	15
Satinwood	1,903	29
Mulai	1,004	16
Ranal	925	15
Chonumtiri	1,333	18
Nedun	1,486	21

In a few cases the shearing resistance is rather low for leafwood timbers. In most instances, however, it is as high as or higher than that of timbers commonly used. Amongst the medium timbers there are seven which have greater shearing resistance than American oak. The figures in the last column show the relative values of the timbers as regards shearing strength.

Tour through North Derbyshire, England.

Having lately been on tour in North Derbyshire, I took the opportunity afforded of visiting some of the famous caverns and mines of that interesting part of England.

The first cave inspected was that known by the name of Poole's Cavern situated near the fashionable town of Buxton in the north-west part of the country.

The geological formation of this part of Derbyshire consist of the mountain limestone, and the prevalence of the numerous caves and grottoes is probably due to the shrinking of the rock when it cooled down, also to the action of water, afterwards modified by the formation of stalactites and stalagmites on the roofs and floors of the caverns.

The former may be called lime-water icicles and are produced by the gradual depositing of lime by slowly oozing water, charged with carbonate of lime.

The cavern referred to is entered by a small opening situated about half a mile from the town of Buxton, the whole length of the cavern available for the inspection of visitors being about half a mile.

As we proceeded into the cave the guides lit up numerous gass jets, so that all details can be seen in the most perfect manner.

The floor of the cavern runs pretty level for about half the distance, when it suddenly descends and the path crosses a considerable stream of water, which comes from a source situated far up the mountain and runs underground for a long distance.

The path which is good and about 6 feet wide, passes through various caves and grottoes, one of which is about 200 feet high with a breadth of about 100 feet.

In other places the cavern is much narrower and the path meanders about through some pine formation of stalactites and stalagmites which often join so as to form arches with pillars of very regular shapes all along the route.

In some places the dropping lime water is charged with sulphur which results in the formation of a bright yellow deposit locally called poached eggs, but of a decidedly unwholesome appearance. The cavern ends in a large grotto down a corner of which the stream suddenly disappears, and goes to join the Derwent River at a point two or three miles off below Buxton.

The top of this chamber is said to end in a small opening 500 feet above, but the ordinary visitor is not allowed to attempt the ascent which is both difficult and dangerous, so we retraced our steps by the same route and much pleased with our visit.

This cavern was evidently inhabited by the ancient inhabitants of the land, as numerous flint weapons and bones of extinct animals have been found, and are now to be seen at the small museum situated near the entrance to the cave.

During more modern times the cave was also inhabited by a noted free-booter called Poole from whom it takes its name, and who for many years made the cavern his place of retreat from whence his gangs sallied forth to plunder the inhabitants of the surrounding country.

I next proceeded by bicycle to Castletown situated in North Derbyshire, and this place constitutes a convenient centre from which various caverns and mines can be visited.

The first mine inspected was the famous Speedwell lead mine situated about a mile from the village of Castletown.

This mine was opened about 100 years ago by an enterprising Compamy in its search for a workable seam of lead ore, but after ten years of hard and incessant labour it had to be abandoned on account of the lead not being obtainable in sufficient paying quantity.

After being provided with candles we entered the mine by means of a flight of 106 steps, and at their bottom we found ourselves at the entrance to a long tunnel 9 feet by 7 feet, about three feet of which was filled with water.

A boat was here found waiting for us which we entered and proceeded along the flowing passage, which was, however, soon lighted up by the guides, who placed pieces of candle in small nitches as we proceeded onward, the boat being propelled by the guides shoving with their hands against the side of the rock.

The total length of the section of the tunnel along which we sailed is 750 yards and on approaching the end, the roar of falling water was suddenly heard, and finally all further progress was barred by a considerable stream crossing the tunnel, where it forms a fine waterfall, the local name for which is the bottomless pit waterfall.

This stream comes from a point situated far up the mountain and eventually emerges from the ground near Castletown. The water having been ascertained to take 24 hours to get there though the direct distance is only about two miles, so that it meanders for a long distance under ground.

Across the abyss formed by the waterfall a bridge has been constructed, and the tunnel extends for about a mile further on the other side, but as its examination necessitated wading through three feet of water, we did not feel inclined to proceed further in that direction.

The height of the cavern of the place where the waterfall is encountered is over 450 feet, rockets having been fired up to that height without reaching the roof, but the breadth is only about 100 feet.

After collecting some lead ore specimens and listening to the peculiar echoes caused by the falling water and the shouts of the guides, we returned by means of the boat and stairs to the mouth of the mine.

The next place of interest visited in the neighbourhood of Castletown was the famous peak cavern. The entrance to this cave is situated at the end of a rocky chasm quite close to the village and is surrounded by precipitous limestone cliffs on the top of which is placed the famous Peveril or Peak Castle.

The peak cavern consists, in the first place, of a wide entrance chamber of about 100 yards by 60 yards and 50 feet high, the rock being mountain limestone. Within this spacious cave a number of local villagers and their ancestors before them have from time immemorial carried on a rope and twine manufacturing industry, the shelter afforded by the cavern enabling them to carry on the work all the year round.

At the end of this cavern, and after having been provided with lights, we proceeded into the further recesses of the cave, which we entered through a low arch or tunnel.

After traversing this for about 20 yards we found ourselves inside the first great cave called the "Bell home" which is about 100 feet high and 50 feet broad.

Between this and the next cavern a considerable stream is crossed, which emerges from the side of the cave and flows through the remaining length of the cavern.

The second cave is called the Grand saloon and is about 220 feet square and 120 feet high.

Many fine stalactites are to be seen hanging from the roof of the cavern, and they can be well seen by the aid of limelight which the guides lighted and held high over head.

The path then winds on through various caves and grottoes and after ascending and descending and crossing the stream several times, it at last terminates in a large chamber called the Devil's cellar down which the stream disappears.

The stream is supposed to be the same as that we already lost sight of in the Speedwell mine, and as the passage is somewhat contracted further on, the result is that in time of heavy flow this cavern also is flooded and remains so for some time.

On the mountain top, immediately above the Peak cavern is situated the famous Peveril Castle, which is said to have been built by a relative of William the Conqueror.

Although it is said to be one of the most ancient castles in this part of England, it still forms an imposing object and will doubtless brave the elements for many years to come.

The possession of the castle did not remain above 100 years in the family of the Conqueror, and it now belongs to the Duke of Devonshire who now owns extensive estates in the county of Derbyshire. The main keep of the castle consists of a huge quadrangular town 300 feet by 150 feet and 100 feet high and one peculiarity about the buildings is that the facing of Ashler has completely fallen or been pitched off. The backing, however, which consists of a solid masonry wall about 6 feet thick, remains intact, but the circumstance noted shows that the binding of the two parts of the work could not have been very carefully done in those days.

The principal dungeons of the ancient castle are supposed to have been connected with the peak cavern already described, and doubtless the ancient lords of the castle found them a convenient

means of getting rid of superfluous and undesirable prisoners by casting them into the cavern beneath. I concluded my visit to Castletown by inspecting the famous Blue John or Zopasine fluor-spar mine which is situated on the top of a hill about two miles from the village.

This mine is the only place where this particular kind of fluor-spar is found in England, and the only other place where it is found in Europe is in the State of Saxony in Germany.

The mine is said to have been commenced by the Romans, who had an encampment on the neighbouring hill, several vases made from the spar having been found amongst the ruins of Pompeii in Southern Italy.

The mineral is composed principally of fluoride of lime, coloured blue or purple by manganese and varies in hue from dark blue to brownish purple.

The amount of the mineral quarried owing to its scarcity is very small, besides which the quantity to be removed is limited to 3 tons per annum.

The entrance to the mine is effected by means of a flight of steps leading down a sloping tunnel or shaft, commencing from a point situated on the ridge of the Peak range of hills near the Speedwell mine already described. After descending for about 200 yards a large cavern is reached which being remarkably dry was formerly used as a place of residence by the miners.

From this point a winding pathway leads past numerous clefts and tunnels representing the old workings, the extent of which has not been ascertained, though they have been traced for a distance of several miles in various directions.

At last we arrived at what is called the Crystallized Cavern, the roof and sides of which are thickly studded with glistening rock crystals.

We also passed through an archway formed of stalactites and stalagmites, which were quite transparent and which resemble in appearance the pipes of an organ.

It is to be regretted that those beautiful formations have been much damaged by the hammers of vandal tourists and geologists.

The height of the crystallized cavern is about 100 feet and breadth 50 feet, and when it is lit up with the lime-light, the roof and sides present a dazzling appearance.

It is in the neighbourhood of this cavern that the Blue John spar is now being worked, small tunnels being run in various directions in pursuit of the veins which are most eccentric in their ramification, so that the spar is most difficult and expensive to work.

The Blue John spar is principally used for the manufacture of vases, plates, knife-handles and other ornamental articles which, though rather expensive, are much appreciated by visitors, the

articles made from the dark-blue coloured spar being the most valuable.

From a Forest point of view, North Derbyshire cannot be said to be well wooded and considerable acres of moors or commons exist, thickly covered with heath and heather.

On the lower slopes of the hills and in the valleys numerous small plantations of larch, oak, Scotch fir, beech, &c., are met with, but none are of any great extent.

The timber is principally used locally for making fences, and for pit or mine props, there being numerous coal mines situated to the north and east in Yorkshire and Northamptonshire.

The agriculture of this part of the country is principally pastoral and numerous fine herds of cattle and flocks of sheep were observed.

It is to be noted that the fields are separated by dry-stone walls, and the houses are all built of stone, live hawthorn hedges and brick-houses being the rule in most other parts of England.

The central part of Derbyshire is, however, much better worked, especially the fine estate of Chatsworth belonging to the Duke of Devonshire.

On this estate numerous fine woods and flourishing plantations were observed, consisting principally of larch, Scotch fir, oak, ash, elm, &c.

Amongst numerous exotics planted round about the castle, I observed many fine specimens of deodar, cedars of Lebanon, Cryptomeria Japonica, Douglas pine, Araucaria, &c., picturesquely interspersed with fine clumps of Rhododendrons of various shades, and those when in full bloom present a gorgeous sight.

There is a fine garden and orchard attached to the castle and one of the finest palm-houses to be found in England.

The castle itself, situated on the borders of a lake, is a most imposing building, and a considerable portion of it is always open for the inspection of the public, except, of course, when the Duke is at home.

The castle contains many fine pictures, statues and other valuable works of art, including a famous Blue John fluor-spar vase, valued at £700.

E. McA. M.

Egg-blowing and its Difficulties.

All bird's-egg collectors must on many occasions have experienced the vexation, amounting not rarely to actual grief, caused by finding a valued clutch of eggs so hard set, as to render blowing difficult, if not impossible; and I think from my own experience the following procedure, which I am not aware of

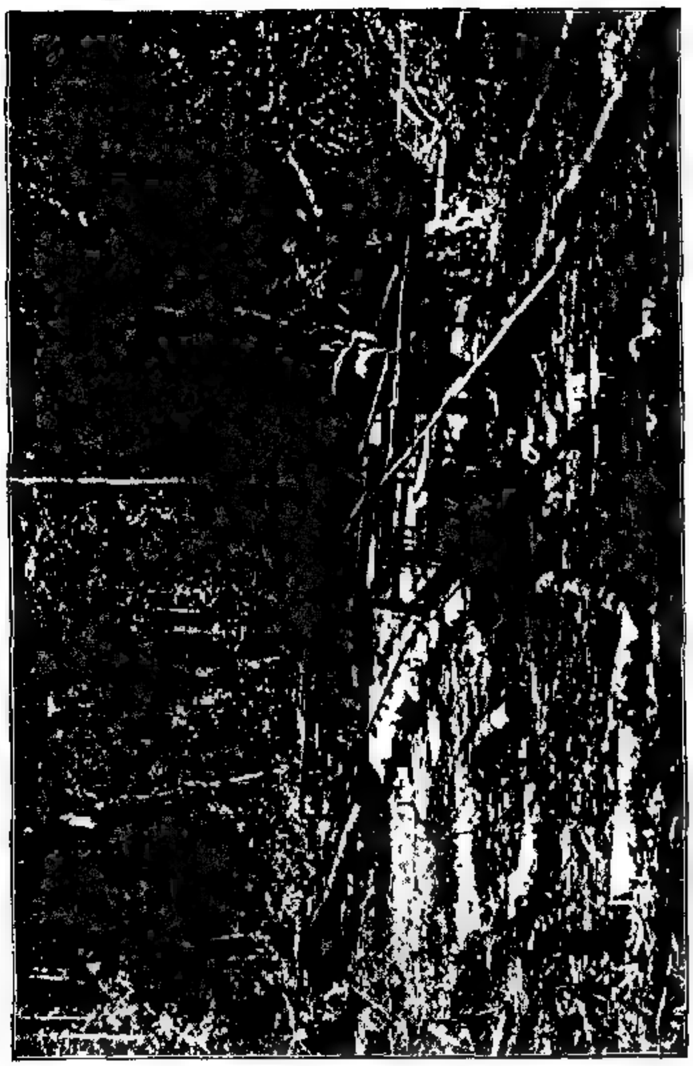
anyone but myself having practised, worthy of publication, and trial by others. It occurred to me after taking my 5th clutch of *Brachypternus aurantius*, all endeavours to blow the eggs on every occasion having proved equally futile. On this occasion I had spent about half an hour using every endeavour to rid the first egg of its contents, and finally, in spite of a large disfiguring hole from which all else had been evacuated, I found that the head refused to budge. I filled the egg with water and placed it hole uppermost on my table, intending to try the results of maceration, this at about 6 P.M one evening. On the following morning with no effort the head came out. The other eggs of the same clutch I treated similarly, making only moderate holes, and I found no difficulty in blowing all.

I have since tried this method on many occasions and with wonderful success. Of course there must be a limit to its effects, but I find in those cases where after some trouble most of the contents have been liberated and where a limb protrudes, portion of which may be got away, it is wisest to go no further but to try maceration. and I think I may venture to say that an egg is blowable in this way perhaps three days later on in the incubation (of moderate-sized birds, than the usual methods adopted can render it so.

In the hills no doubt the period of maceration would require to be more lengthy.

The egg is left with an odour of putrefaction which I overcome by blowing in weak Condy's fluid

[*F. Wall, in Journal, Bombay Natural History Society.*]



THE

INDIAN FORESTER.

Vol. XXVI.] November, 1900. [No. 11

The Monorail Portable Railway.

Cheap transport being undoubtedly one of the most pressing necessities of modern life, I have deemed it not unlikely that a few lines on Caillet's Monorailway, the acme of cheap transport, *might prove interesting and useful to those whose work leads them* to seek for facilities and cheapness in transport. The expansion of trade has produced the locomotive, light railways, tramways, motor cars, electric traction, &c., proving that, although the day of the flying machine has not yet dawned, our Engineers have been by no means backward in providing a variety of methods of transport, and it becomes only necessary for those who wish to avail themselves of facilities of this kind to first carefully consider the conditions and environment of the proposed line. Just as there are certain purposes for which great power, great speed, and great carrying capacity are essential (*e.g.*, an express locomotive, weighing 70 80 tons) and which cannot be obtained in combination without a corresponding outlay and upkeep; so there are other services when the requirements are of a more limited and less pronounced nature, and when, therefore, the manufacturer is able to give the customer full advantage of economy, lightness, and reduction of friction to a minimum. It is of this latter class of service that I propose to draw attention to in this article. In many cases a great deal more money than is at all necessary is laid out on transport facilities, particularly in factories, engineering yards and other industrial establishments, whilst in other cases the fear that this first initial outlay will prove prohibitive, deters the owner from fully exploiting his mines, forests, &c., to their maximum yield. In many such cases the introduction of the Monorail would prove of the greatest advantage. The Monorail has, I believe, been brought into extensive use in France and is being laid down in different parts of the United Kingdom.

Without going too much into detail, it will be in the first place necessary to describe shortly this Monorail system, and this

can be best done by the extraction of a few notes from the prospectus of the Company. The plant consists, broadly speaking, of a single rail of light section, fitted with steel sole-plates at intervals of a few feet, Figures I and II, and is laid down direct on the surface of the ground, without sleepers, ballasting, or other preparation. The rails are joined together by scabbard fish-plates, which fit the lower part of the rail, and are slid along so as to form the joints, thus obviating any necessity for weakening the rail by boring holes in it. Among the chief advantages of the system are, the great rapidity with which the line can be constructed, and the circumstance that it is ready for operation immediately after being laid down. The rolling-stock is divided into two classes, light and heavy, the former intended for propulsion by hand, and the latter by animal power. It consists of cars, trucks, and other vehicles of various sizes, and forms according to the use for which they are intended. These run on two wheels of the same size, one placed before and one behind the car, or fore and aft, the bearings being in the under-frame on which the car is built, the light rolling-stock can be used for the transport of all sorts of merchandise and is so constructed that one man can effect the transport of a load of from 6 to 8 cwt. without difficulty. The heavy rolling-stock intended to be drawn by horses, mules, cattle, &c., can be used for the transport of bulky material, including tram cars capable of carrying twelve to sixteen people. The above is interesting as showing that the Monorail is capable of proving useful to all sorts of industries and productions, and in a country, such as India, where coolie labour is cheap, it should prove invaluable. The circumstance that only one rail is employed at once invites considerations as to the question of balance. It might have been thought that considerable difficulty would have been experienced on this point, but in practice the trouble is reduced to very small dimensions. The rolling-stock is put in motion and balanced on the rail by means of a lever in the form of a rod, which projects from the back of the car at a right angle to the rail. This rod is telescopic, so that it can be lengthened at will to suit circumstances; and since it has only to equalise any uneven distribution of load, it is found to keep the car balanced with a minimum of power. Assuming that the car is so loaded that its balance is nearly exact, it is clear that no effort has to be put forth except that necessary for propulsion, and it is said that it is generally found in practice that the act of propulsion maintains the car's equilibrium without any special effort. Moreover, the bottom of the car is only a few inches above the rail, and a semi-circular projection is provided under each side, so that when resting and during loading the car lies at an easy angle and this renders it almost impossible for them to overturn on a steep hill side. For the heavy rolling-stock two levers are provided instead of one, and these are connected by rods which form the shafts in which

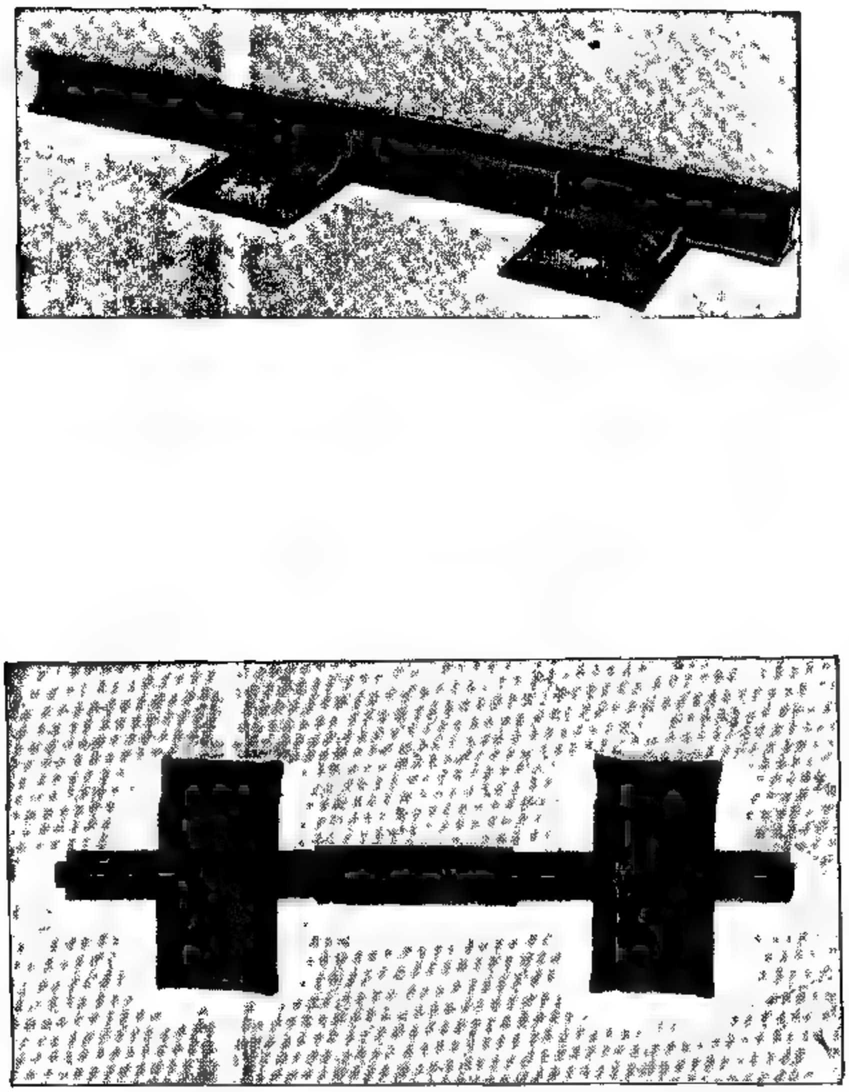


FIGURE I

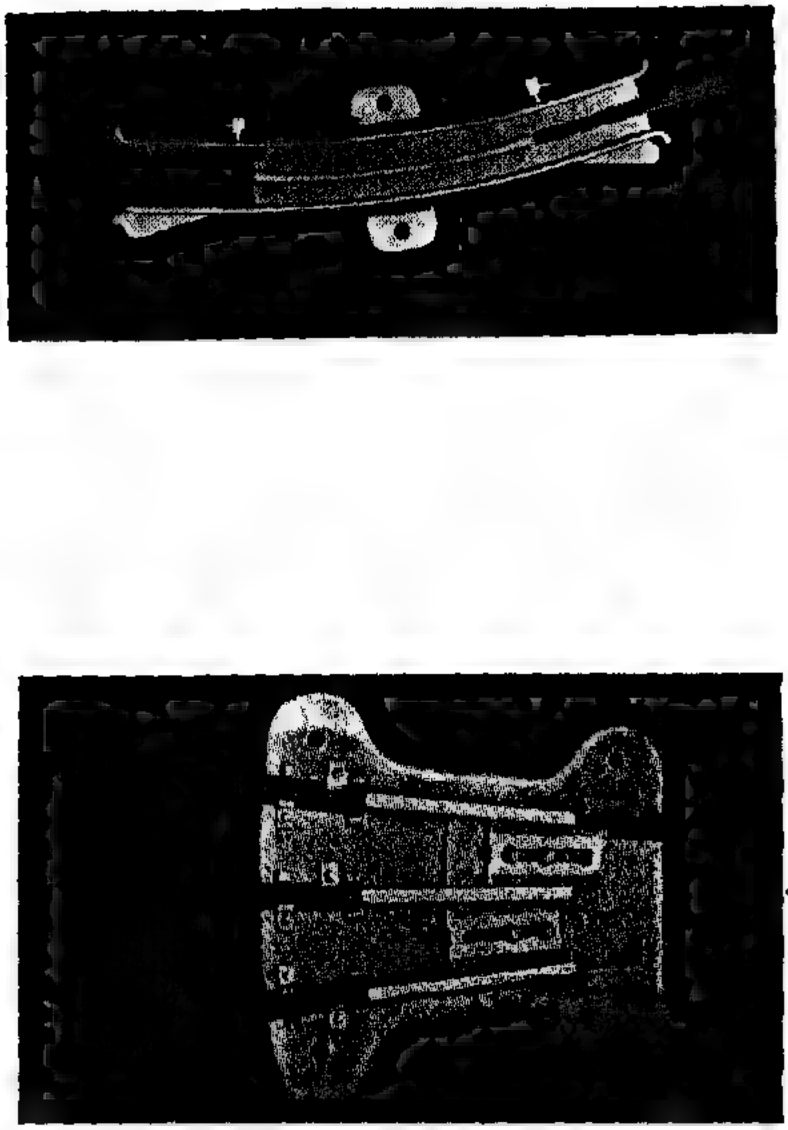


FIGURE II.

the animal is harnessed. The makers state that 2 tons can be taken as an ordinary load for a horse or mule.

From the above it would seem to be more than probable that the Monorail could be introduced with profit in the Forests and Tea Gardens, situated on the steep slopes of the Himalayas, where the question of transport owing to the difficult nature of the ground and consequent great expense involved is an ever present difficulty. Owing to the rapidity with which it could be laid and its cheapness and greater carrying power, it could also not unlikely be used with advantage in military expeditions on the frontiers and elsewhere for the carriage of stores, ammunition, &c., to an advanced base.

There are five types of rail available, ranging from rails of the Vignolle's type, weighing only 9lbs. per yard, to a type of rail weighing 24lbs., the sole-plates varying both in size and number according to the firmness or softness of the surface to be traversed. The standard length of rail is 16 feet 6 inches, but sections of 8 feet 3 inches and 4 feet 1½ inches are also made, each rail being fitted with sole-plates and with a scabbard fish-plate. Curved rails, switching points, crossing points, &c., and powerful brakes, are all provided if desired.

The manufacturers in summarising the advantages of their Monorail system, draw especial attention to its simplicity and cheapness as compared with the tramway and light railways. They point out that by presenting a uniform and continuous surface, it prevents the jolting and jarring which result from traction over uneven roads and so is suitable for the conveyance of fragile goods. It is claimed that as regards road traffic the use of the single rail reduces the effort of traction and consequently the requisite number of men or animals by about *four-fifths*. Loading and unloading are facilitated by the low level of the platforms. The line is not rendered useless if put out of shape and requires but little precision in laying. Moreover, the line is laid without sleepers or ballasting or levelling of the road-bed, items of considerable expense in laying double rails. The line's construction and use require no technical staff, an enormous advantage in a country like India where the maintenance of such staff is most costly. Its use with hand traction is claimed to effect an economy of as much as 90 per cent. of labour. Its portability renders it not only easy to carry, but capable of being packed and stored in a small space since the single line weighs half the equal length of double line rails. Its first cost laid down is considered to be less than the expense of a cart road, and is held to average only about one-fifth of that of some of the narrow-guage systems. Its cost and maintenance is very small.

The Monorail should prove of immense use, as I have already mentioned in the working of forests, mines, the tea, indigo, sugar, and jute industries, &c. The cheap transport of forest produce in paying amounts from our Indian Forest is one of the great

difficulties the department has to deal with, and this is more especially so in the case of our hill forests, the question of the initial outlay having always to be taken into consideration. I am of opinion that the Monorail will solve this difficulty to some extent, and should advise that a combination of it with the wire rope system be introduced in a practical manner and given a fair trial in our forests. In the Darjeeling and other hill divisions in the Eastern Himalayas the cost of transport is very high and entails a corresponding increase in the price of forest produce, more especially felt in the case of timber and fuel. In the Darjeeling Division I have advocated the judicious combination of the Monorail system with the wire rope as the most feasible means of both cheapening the cost of the produce extracted, whilst at the same time enabling the provisions of the Working Plan to be fully carried out.

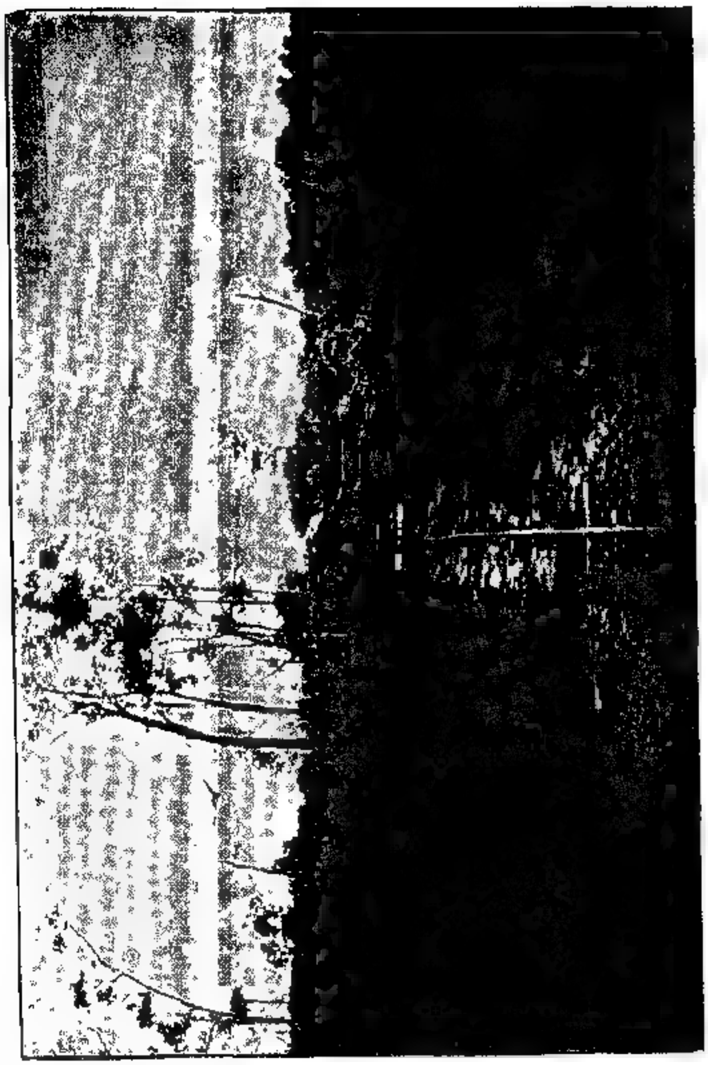
As an example of the great saving of labour that results from the use of the Monorail, it has been ascertained that in the Mahogany district, in Western Africa, it takes twenty men to move a log of two tons, and that only two journeys of one mile each are made in a day. With the Monorail four men would make at least ten journeys a day which is equivalent to carrying twenty tons one mile per day. Therefore four men with the Monorail will do in one day as much work as is now effected in Western Africa in twenty-five days. It has been stated above that its cost is very low when compared with that of other systems. Roughly speaking, the cost of an ordinary tram line would be £2,000 to £3,000 per mile, including equipment, whereas the Monorail system would cost from £250 to £400 per mile, including equipment, according to circumstances.

To my knowledge there is no instance of this Monorail system having been laid down in India, and I have written this article with the object of drawing attention to a method of transport which would appear particularly adaptable to various industries in this country, its introduction requiring no costly initial outlay, it being possible to lay the rail down over any kind of country without the previous preparation of an expensive tramway road or permanent-way.

The diagrams given show the nature of the plant required to lay down and work the monorailway. It will be seen that it is simplicity itself.

E. P. STEBBING.

Since writing the above, I have received the following interesting letter and estimates from the London Manager of the Monorail Company. It will be seen from them that a project is on foot to lay down 56 miles of the railway in India, in addition to others in Africa and South America.



I have recently drawn the attention of the Assam-Bengal Railway authorities to the great convenience of the rail. The Chittagong Section is at present being ballasted and the stone is being extracted from quarries and river-beds, situated in a small range of hills running parallel to the line and from 1 to 5 miles distant from it. I have advocated the more important of these quarries being joined up with the line side by means of the Monorail system, and the project is, I believe, receiving consideration.

The following is the letter, with its enclosures, recently received :—

CAILLET'S MONORAIL.

22-23, LAURENCE POUNTNEY LANE,

London, E. C., 27th July 1900.

DEAR SIR,

I was unable to answer your letter of the 25th June by last week's mail, as I was absent on the Continent.

I was much interested to hear that you had written a paper on our system and have sent you this week the blocks shown on page 9 of our catalogue, together with four other blocks illustrating the Carsevene line, which, I trust, will reach you safely.

In order to show you more fully the advantages to be gained by the use of the Monorail in place of carts, &c., I enclose you some estimates which have lately been prepared in this office. The proposed line in the Argentine will be built as soon as the purchasing Company have completed an issue they are about to make for the purpose of raising the necessary capital.

The line for Africa is in the same position, but we are promised the order within the next few weeks.

Judging from the information which has been given to me by one of the leading Indian Engineers, I believe our system to have a great future in India, especially since the loss of oxen owing to the famine has been so heavy, necessitating either the adoption of porterage in place of cartage or the adoption of some system which will increase the efficiency of the animals remaining.

You will see from the estimates enclosed for certain projected lines in India that we are now in close touch with the projectors. Authority for laying these lines has already been asked for, and as soon as same is received, we shall be in a position to go ahead.

I am,

Dear Sir,

Yours faithfully,

C. C. H. MILLAR.

(Enclosures.)

INDIA,

56 Miles.

	£
56 Miles, 14lbs. rail · 6 heavy sole-plates, at £275 ...	15,400
100 Trucks, type 131, at £25	2,500
70 Do. do 56, at £48	3,360
Duplicates, construction and other cars, brakes, points, &c.	2,240
Cost *f.o.b.* Antwerp ...	23,500

	£
Cost *f.o.b.* Antwerp, as per estimate	23,500
Weight about 750 tons, freight at £30	1,125
Construction, say	1,000
Contingencies	1,000
	26,625

CARRYING CAPACITY.

56 Miles divided into 7 sections of 8 miles each.

1 Truck will do a round section per day, *i.e.*, there and back.

7 Trucks will carry a load the whole journey per day.

70 Trucks, type 56, capacity 200 cubic feet, will carry 10 * tons per day = 3,000 tons per annum of lose cotton.

100 Trucks, type 131, load $1\frac{1}{2}$ tons, will carry 20 tons per day = 6,000 tons per annum.

Cost of Carriage.

2 Oxen and 1 man per cart or truck, cost 16*d.* per day. Cost for 170 trucks = £11-10-0 per day; for 70 tons = 7*s.* 3*d.* per ton = about $1\frac{1}{2}d.$ per ton per mile.

Cotton now costs per cart, 3 cwt., 1*s.* 4*d.* for 18 miles = 9*s.* per ton for 18 miles = 6*d.* per mile = 27*s.* per ton for the journey.

INDIA.

Passenger Traffic, 8 Miles.

	£
8 Miles, 12lbs. rail, 4 large sole plates, at £225 per mile	1,800
12 Tram cars, type 168, 12 passengers . double brake, at £40	480
Allowance for crossing stations, points, harness attachments, duplicates, packing, &c. (to be invoiced separately)	250
F.o.b. Antwerp ...	2,530

Total weight about 100 tons.

* Weight capacity, 28 tons per day = 8,400 tons per annum.

Allowing 2 hours for the journey, 8 cars would work a half-hourly service each way: with four cars in reserve.

Cost per diem a 1*s.* 4*d.* per car: 10*s.* 8*d.*

Will quote later for better cars.

AFRICA.

Statement showing Economy by the use of Caillet's Monorail instead of Porterage by natives.

Distance—35 Miles.

Natives carry loads up to 56lbs.

	£
Up traffic, 3,500 tons per annum, present cost 28*s.* per ton ...	4,900
Down " 1,500 " " " " " 20*s.* " ...	1,500
Total cost of transport ...	6,400

Native labour being plentiful and cheap and animals scarce, hand traction cars would be supplied.

Owing to hilly nature of the first 14 miles, 8 cwt. is considered a fair load to be worked by two men.

In order to move 75 tons per fortnight, which is the average traffic, and calculating that it takes two days for the Up journey and 1½ days for the Down journey, the 75 tons divided into loads of 8 cwt. require 190 journeys. This would necessitate 60 cars being provided.

Each journey with two men at 9*d.* per day each = 3*s.* per car, carrying 8 cwt. or 7*s.* 6*d.* per ton, but 2*s.* 6*d.* per ton should be allowed for contingencies making cost for Monorail on 5,000 tons per annum at 10*s.* per ton = £2,500.

This shows a saving of £3,900 per annum on an outlay for plant, freight, insurance and actual laying of the line of £9,750 (as shown on estimate herewith). The saving on present cost (after allowing 5 per cent. for interest and 5 per cent. for depreciation on the cost of Monorail) amounts to 45 per cent., not taking into account the saving of expense at the loading station affected by the goods not having to be subdivided into small loads.

Estimated cost of 35 miles of line with equipment to deal with 5,000 tons annually.

	£
35 Miles of 9lb rail with 1 fish-plate and 1 heavy sole-plates per rail, at £200 per mile	7,000
½ Mile for crossings	100
100 Points, at £2	200
60 Cars, type 61, at £13	780
10 Cars, type 39b, at £15	150
Sundries, duplicates, etc.	110
	8,340

Charges.

	£	£
Ocean freight on 330 tons at 40s.	660	
Insurance, say	40	
Cost of landing, etc.	160	
Do. of laying estimated at	500	
Unforeseen expenses	50	
		1,410
		9,750

E. & O. E.

SOUTH AMERICA.

Transport of material in bags.

Showing cost of transport to port of shipment by present means and by use of the Monorail system :—

Distance ...	... 114 miles.
Average grade	... 3 per cent.
Maximum grade	... 8 "

By present means 140 pack-mules can bring down 9 tons per week at a cost of £62, *i.e.*, nearly £7 per ton, or 1s 2d. per ton per mile, calculated as follows :—

		£
Wages.—		
6 Station men, 14 Muleteers		20
Fodder—		
9 Tons hay at £3 ...	£27	
2 Tons barley, at £5 ...	10	
		37
Supervision—		
Manager		5
		62

The route is divided into seven sections of about 16 miles apiece, each section being provided with station accommodation for 20 mules and their drivers. Each batch of 20 mules is in charge of 2 drivers and transports 3 tons from station to station in one day, the next day being occupied by the return journey; thus giving an average delivery of $1\frac{1}{2}$ tons per day or 9 tons per week. In addition to the mule-drivers there is a man in charge of each station and a manager to superintend the traffic

By Monorail the mules will be disposed in a similar manner, but the route will be divided into 5 sections in place of seven, and 10 mules will start from each end of each section daily, and as each mule will draw a truck containing $1\frac{1}{2}$ tons, the average daily traffic will be 15 tons, *i.e.*, 90 tons per week or 10 times the amount dealt with by present means.

Owing to the reduction from 7 to 5 of the number of sections into which the journey is now divided, the number of draught

animals will be reduced in corresponding proportion from 140 to 100, though in practice it will be as well to count on the extra 40 mules as still being retained to assist where gradients are steep and to fill any vacancies caused by sickness, &c.

The number of hands for the station work will be reduced to 4 and a manager. Allowance must, however, be made for an increase in the number of men required to look after the trains of trucks. Thus 3 men would be deputed to look after each train of 10 trucks instead of 1 man to each 10 mules, making a total of 6 men per section or 30 in all.

The increased traffic of 90 tons per week will therefore cost £76, *i.e.*, 17*s.* per ton or 1*s.* $\frac{3}{4}$*d.* per ton per mile, calculated as follows :—

			£
Wages—			
4 Stationmen, 30 Mule teers	...	...	34
Fodder—			
(As before)	...	...	37
Supervision—			
Manager	...	...	5
			76

Referring back to the cost of transport by present means, it will be found that by the use of the Monorail system a saving of over *six-sevenths of the cost per ton is effected.*

On separate sheet will be found estimate of cost of Monorail line, equipment and laying, necessary to deal with a traffic of 4,000 tons per annum in each direction.

Estimate showing cost of Monorail Line and equipment necessary to deal with a traffic of 4,000 tons per annum in one direction; or 8,000 in two directions.

Distance—114 *Miles.*

	£
114 Miles of 14lb. rail, 16½ feet long, fitted with 6 sole-plates and 1 fish-plate, at £250 ...	28 500
2 Miles (as above) for crossings at stations en route ...	500
120 Trucks, say, £30 ...	3,600
Accessories, construction cars, duplicates, etc., say ...	1 150
	33,750
Freight on 1,520 tons at, say, 30*s.* ...	2,280
Cost of laying estimated at ...	1,500
Cost laid down ...	36,530
Cost of transport per ton on 4,000 tons in one direction ...	£0 17-0
Allowance per ton for interest and depreciation (10 p.c. on cost) ...	,, 0 18 0
Total cost per ton ...	£1-15 0
With a traffic of 4,000 tons in one direction and 2,000 tons on the return journey, cost per ton (expenses being the same) would be one-third less, *i.e.*, total cost per ton, including interest and depreciation ...	£1 3-4

The Insect Plague in Deodar Pole Forests.

So far I have seen but one species of a perfect insect.

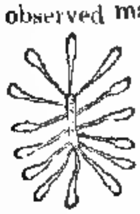
There can be no doubt that it belongs to the *Scolytid* family, and I make it out a *Scolytus sp. (Ecoptogaster)*, and neither a *Hylesinus* nor *Tomicus* for the following reasons; but this should be ascertained authoritatively, as *Scolytus* in Europe does not attack pines, and my lens is not very powerful and

somewhat scratched. The shield is square and neither tapering as in the *Hylesinus* nor round as in the *Tomicus*. Moreover, it is larger than the wing covers.

The insect is therefore no *Hylesinus*. The head is sloping and observable from above and not round and hidden as in the

Tomicus. The wing covers are straight and not abruptly cut off as in *Tomicus*, and the hinder portion of the abdomen slopes upward and is not horizontal as in both *Hylesinus* and *Tomicus*. What species it is, I do not know. The insect was first observed by Mr. Minniken in August

last, but is even now busy eating through the bark of living Deodar poles or engaged eating galleries below the bark. These galleries are irregular. I have observed many old galleries without a trace of the complete insect,



with egg-chambers at intervals. From these egg-chambers the larvæ have eaten their way in a very regular way, the galleries increasing in size as the larvæ grow. In many instances I found the white little larvæ curled up in the end of these galleries in the pupa cradle, in others I found a hole whence the complete insect had evidently escaped. In no instance did I observe a complete pupa, though in two instances I

found the live larva enshrined in a web-skin. Now it is quite evident that the egg-chambers and larva galleries from the pupa cradles of which the insect has found its way out, belong to a past generation, and it is possible that those in which the larva are still embedded, are part of the present generation which would indicate that the complete insect has been swarming for some time before it was observed. I am confirmed in this opinion by the fact that when I observed the larvæ already embedded, this happened at a somewhat lower elevation, whereas at a higher elevation the perfect insect was more active. The question whether the former generation belongs to a previous year or whether more than one generation appears in the same year, must remain for future observation. I have not sufficient material to solve the question. That, however, there has been a hiatus between the two generations is evident by my not finding a single complete pupa. I am inclined to believe that the larvæ winter in the pupa chambers, probably in the pupa stage; this should be ascertained later on. The larva has no legs. The matter has been somewhat complicated by the finding of a red larva in the galleries.

This has been sent to Mr. Stebbing and others as belonging to the insect which I identify as a *Scolytus sp.* It has, in my opinion, nothing to do with it if not as an enemy. To begin with, it is about five to six times the size of the complete insect, has three pairs of complete legs, has strong flat mandibles and two hooks to its other end, twelve distinct rings. Its colour is a fleshy pink.

The insect found in and destroying large numbers of *Pinus excelsa* poles is different, though it was at first considered to be identical. It is a *Tomicus*: about this I have no doubt. The wing covers are tunicated and swallow-tailed. The abdomen level. The same insect is sometimes dark-brown, sometimes yellow, as is the case in Germany. The larva galleries and pupa cradles are more irregular than with the Deodar insect. Its attack when it has taken place, is much more serious. I have not found the *Scolytus* above described in *Pinus excelsa*, nor the *Tomicus* in Deodar.

Specimens of both insects, as well as of the pink larva above mentioned, and a small beetle found plentiful in the *Tomicus* larva galleries, have been sent to the Indian Museum for authoritative identification.

The 1*st October* 1900. S. A. C.

A few notes on some Statistics for Working Plans in the North of Ceylon.

As at last in the North of Ceylon the reservation of our forests is being taken up seriously, over 50,000 acres having been gazetted during the first six months of this year, a few notes I have made prior to forming working plans of our forests may be of interest to your readers.

Enumeration Surveys.—A block of about 400 acres was taken up, in which fellings were to take place this year. It is situated near the town of Vavoniya. The country is, as a rule, flat or very slightly undulating. The following classes were adopted: trees over 6′ in girth, 1st class trees; between 4′-6″ and 6′, 2nd class, and trees between 3′ and 4′-6″, 3rd class. The other smaller-girth classes were not counted.

About 30 acres or so were old *Chena* land, *i.e.*, land on which shifting cultivation had been practised ("taungyá") and on which there were no trees standing. The following was the result:—

	Classes			Total.
	1st.	2nd.	3rd.	
Diospyros Ebenum, Ebony ...	6	77	132	215
Chloroxylon Swietenia, Satin ...	57	113	242	412
Mimusops hexandra, Palu ..	459	932	380	1,7[illegible]1
Others	20	104	95	219
Total ...	542	1,226	849	2,[illegible]7

The striking parts of this enumeration to my mind are as follows :—

(*a*) The large number of trees of valuable species growing, although fellings have taken place within the last 20 or 30 years, and considering nothing has ever been done in the way of improvement fellings to aid regeneration.

(*b*) The high percentage of 2nd class trees, especially in Palai, and the very small percentage of 3rd class. It seems that the forest is gradually changing from a Palai to a Satin and Ebony forest, as the small percentage of Palai cannot be due to a want of seed-bearers.

I am inclined to think from recent observations that where we find a gravelly soil, Satin predominates, and where it is a clay soil, Palai is more common But it must also be borne in mind that Palai stands wet feet much better than Satin, and the change of species might be brought about by change of climate, I mean an increase or decrease of moisture in the soil would probably affect the young seedlings, *i.e.*, too much water killing off the Satin, or a prolonged drought having the same effect on the Palai.

That there is something in the above theory, namely, that this forest is drier than it was, is also borne out by the results of the enumeration of the subsidiary species :—

	1st Class.	2nd Class.	3rd Class.
High ground species—			
Muls (*Vitex altissima*)	6	19	21
Ronai (*Persea semecarpifolia*)... ...	1	1	11
Water-loving species—			
Naval (*Eugenia Jambolana*)	1	12	1
Pier (*Elaeodendron glaucum*)... ...	4	72	62
Kambuk (*Terminalia glabra*)	6	0	0
Ippa. (*Bassia longifolia*)	1	0	0
Makul (*Mimusops Elengi*)	1	0	0

It will be seen that whereas the high ground species are increasing in number, the water-loving species are rapidly decreasing, in the 3rd class especially. I am inclined to ascribe the change, therefore, to the abandonment of a tank in the vicinity, though it is possible that the climate generally may be drier than it used to be.

Type Trees, or Volume Tables.—Last year in order to get some idea of the *type trees*, 3,967 Palai trees were classified according to size, each size class containing 1 inch and two height classes

were made, *i.e.*, trees 18 feet and under and trees over 18 feet. I annex a Statement A, showing the result and two diagrams; B and C, showing the actual measurements and the probable true mean marked by a red line. These measurements, however, only gave the measurements of logs, after the trees had been felled, so this year I attempted to get at the *Form Factors* of Palai.

Form Factors of Palai. Table D shows the breast-high girth measurement and the centre or middle measurement after felling. From this it will be seen that there is an average difference between the breast-high measurement and the middle girth measurement of 19 per cent. I shall deem it safer and simpler to call this 20 per cent., in estimating the stock of our forests and then we get the following :—

If V = Volume,
H = Height,
G = Breast-High Girth and $(\frac{1}{4}G)^2$ = Basal area,
F = Form Factor
$V = H \times (\frac{1}{4}G)^2 \times F$, or
$V = H \times (\frac{1}{4} \text{ of } \frac{4}{5}G)^2 = H \times (\frac{1}{5}G)^2$.

Should these figures prove of interest, I will endeavour to forward you some more when I have worked out a larger number of trees, when, no doubt, they will prove still more reliable.

H. P. C. ARMITAGE,
Asst. Conservator of Forests,
Northern Circle, Ceylon.

STATEMENT A.—Volume Tables for Palai.

Side in inches ...	6¼-7	7¼-8	8¼-9	9¼-10	10¼-11	11¼-12	12¼-13	13¼-14	14¼-15	15¼-16	16¼-17	17¼-18	18¼-19	19¼-20	20¼-21	21¼-22	22¼-23
Trees 18 feet and under.																	
Number of trees measured ..	2	4	6	22	26	129	363	592	655	495	298	156	59	13	7	...	...
Average cubical contents in feet ..	1·30	5·20	6·70	9·20	11·50	14·55	17·56	19·97	22·61	25·38	27·74	30·96	33·95	34·30	40·26	..	...
Trees over 18 feet.																	
Number of trees measured ..	...	...	2	18	56	165	289	288	172	78	38	14	2	3	12	1	2
Average cubical contents in feet ...	.	...	13·0	16·39	18·00	20·49	22·73	26·11	29·81	33·69	3[illegible]·69	41·71	43·54	52·75	59·32	65·58	7[illegible]·3

Increment between each class in cubic feet. Trees 18 feet and otherwise.

Cubic feet ...	...	·90	1·50	2·50	2·30	3·05	3·01	2·41	2·64	2·77	2·36	3·22	2·99	·35	5·96	...	...

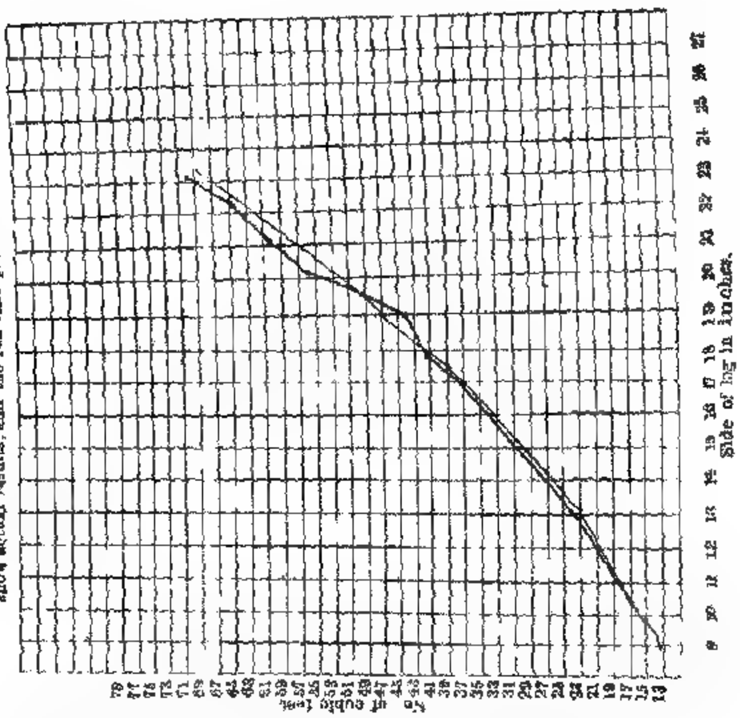
Average increase 2·57 cubic feet.

Trees over 18 feet.

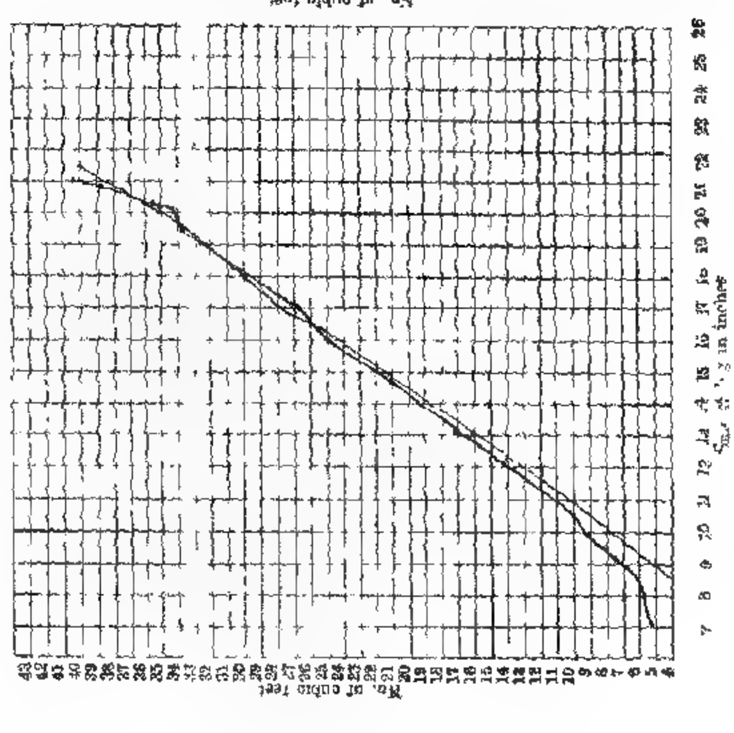
Cubic feet ...	..	...	.	3·39	1·61	2·49	2·24	3·38	3·73	3·75	4·00	4·02	1·83	9·21	6·17	5·66	4·72

Average increase = 4·01.

STATEMENT B.—Diagram showing number of cubic feet in a Palai log over 18 feet in length having a side of -inches. Black lines show actual results, and the red line probable true mean.



STATEMENT C.—Diagram showing number of cubic feet in a log of Palai 18 feet and under in height having a side of -inches. Black lines show actual results, and the red line probable true mean.



Palai Form Factors.

Giving results obtained from 186 *Palai trees from Vettakachi Forest in* 1899.

Breast-high girths	6'-0	6'-3'	6' 6"	6'-9"	7'-0'	7' 3	7'-6	
Number of trees measured.	52	55	39	12	13	8	7	
Total middle girths	251 2	282·1	203·7	66 1	73 6	47 8	41·5	
Average middle girths.	4' 10"	5'-1½"	5' 2½"	5' 6'	5'-8"	5' 11¼"	5'-11'	
Loss in feet and inches.	1' 2"	1' 1½"	1' 3½"	1'-3"	1' 4"	1'-3½"	1'-7"	Average = 1·3½
Percentage of loss ..	19%	18%	20%	18½	19	18	21	Average 19%

Form Factor = say, ⅝ths.

Form Factor = say, [illegible]ths.

The Forests of Java and Their Management.*

Forest Assessor Seibt's paper on the forests of Java is continued in the July, August and September numbers of the *Allgemeine Forst and Jagd Zeitung*, and we review below the portions dealing with the teak forests, which principally interest Foresters in this country.

At the outset the Java teak forests, like our own, were worked in a hap-hazard sort of way, but it was finally recognized that they were not inexhaustible and had to be brought under the systematic working of regular Working Plans. However, this was not feasible at once, for although extensive and expensive surveys had been made of the forest areas between 1860 and 1871, the position of the various classes of forest had not been previously ascertained and rendered intelligible to the surveyors by some sort of demarcation. It would seem also as if no sort of settlement had preceded the survey and the boundaries of the lands at the disposal of Government were uncertain. The result of this survey was a purely topographical map entirely insufficient for the preparation of regular Working Plans. The work had to be begun *de novo*. The prescriptions issued for forest settlements were practical and somewhat on the same lines as those in force in India. Compensation for rights in land were given either by assigning lands in other localities or in cash. The outer boundary of the teak forests was settled in the first instance and subsequently a settlement was effected with the villages within the boundaries. These settlements required the sanction of the Home Department. The settled areas were permanently demarcated with

* Continued from page 512.

boundary marks bearing running numbers. Then followed a new settlement of the proprietary boundaries, as well as of those of different classes of forests, on the scale of 1 : 10,000 (6·33 inches to the mile). The whole of this work was expected from the Divisional Officers.

Progress was naturally slow and scattered, considering the fact that each Divisional Officer had an average of 50,000 hectares (nearly 200 square miles) under his charge, and in 1897 it was decided to add to the strength of the Forest Department a Settlement, Survey and Working Plans Brigade, as it is called.

It would appear that no great advance had been made when the paper under review was written, which consequently occupies itself more with projects for the future than with accomplished facts. The proposals are practical enough and most of them applicable to our forests, but there is nothing in them that is not in some way or other contained in our own preliminary working plan suggestions.

Great stress is laid on the necessity of adapting the selection of compartments to the natural features of the ground and of making the best export line the backbone of every scheme for dividing the forests up into compartments and of laying out all rides in connection therewith as far as possible with a view to facilitating export.

Whilst, however, the preparation of regular working plans is still in a somewhat backward state, considerable progress has been made since 1890 in the promulgation of preliminary plans. A very sensible classification of forests was adopted for this purpose :—

I.—Forests previously felled :—

- (*a*) Areas in which reproduction had failed and blanks.
- (*b*) Areas in which natural reproduction had succeeded.
- (*c*) Areas artificially stocked.

II.—Forests not as yet utilized :—

- (*a*) Areas in which reproduction seems doubtful.
- (*b*) Areas in which successful reproduction may be expected and which should therefore be classed as exploitable.

The main principle laid down was that all that was teak-producing at the time the plan was made should remain teak-producing. No proof is given, but it is accepted that teak trees reach maturity between 80 and 100 years, 30 years in the case of natural reproduction and 10 years in the case of plantings being added to the length of the rotation.

The next, and also correct, principle laid down was that all superannuated forests belonging to Class II (*b*) should be exploited in the first instance. It was further laid down that the system of leases in practice made it desirable to concentrate exploitation

as far as circumstances would permit. In practice it was found best to select areas of from 200 to 500 hectares (500 to 1,200 acres) in one locality and to divide them into annual coupes of *40 to 100 hectares (100 to 250 acres)*; the chief reason for variations being the greater or lesser difficulty in procuring local labour.

The preliminary plans had next to provide for artificial cultivation and finally for thinning and general improvement. It would appear as if these preliminary working plans took too much for granted and in reality afforded no better guarantee for the constancy of the timber supply than the previously unregulated exploitation, though it is elsewhere stated, on what ground is not mentioned, that the present exploitation amounts to little more than 50 per cent. *of the general possibility. They seem not to take into* consideration the present stock of exploitable timber, nor the proportion of the different age classes.

The lease system generally in vogue seems to have driven the Working Plan Officers to have throughout adopted the system of clear fellings and artificial reproduction. The author fully recognizes the mistake that is made in this respect and condemns the lease system as much as any of its enemies in our own Department who had to fight against it in India; but the Java Law of 1874, which maintains the principle of teak exploitation as a *private industry, in its most pernicious form* similar to that practiced under the King of Burma, prevents any progress; and so long as it remains, no regular working plans, however accurate may be the basis on which they are prepared, will effect a system of rational forestry or secure a permanent financial prosperity.

The author devotes some pages to explaining how the lease system is worked and what measures were adopted to make it as little destructive as possible. It is sad reading and need not be further noticed, as for us in India the system is happily dead.

How far the Java law goes, and how great must be the influence of capitalists in that country, is shown by the fact that Government cannot under it exploit their own forests, although not leased at the time, unless the timber is required for state or provincial purposes, and then only under the special sanction of the Home Department. In all other cases the forests can only be worked by the lessees and speculators.

Java produces some 80,000 tons of teak timber per annum of which, however, only 10,000 tons are exported, chiefly in the shape of railway sleepers. At present *the transport of long logs* and squares is attended with difficulties which have not as yet been met; and though the annual possibility of the teak forests of Java is estimated at some 150,000 tons, no rivalry with Indian and Siam teak need be apprehended for some time at least.

Drought and Forests in the C. P.*

Facts bearing on the influence of the recent severe drought on the Forests of the Balaghat district as observed during the open season tours.

Production of edible roots, fruits and flowers.

The production of all edible fruits and flowers, *e.g.*, achar, tendu, bael (fruit of the *Ægle Marmelos*), mohwa, was miserably poor throughout the district. The production of the important edible tuberous roots tikhur, baichandi, and girchi kand, was poor; the tubers being miserably under-sized and absent in several localities (in Raigarh and Sarekha-Bhaisanghat Forest Ranges) annually bearing them.

Early flowering of dhâk (or palas).

The hardy palas (*Butea frondosa*) flowered, in places, in the Lingapownar forests as early as January at the cost of foliage, flower buds having been observed in November and December.

Fruiting.

The whole of the forest species, with the exception of harra, saj and lendia, fruited very poorly, and this fact was observed in every Range.

Aonla fruit.

The fruit of the aonla (*Phyllanthus Emblica*) was, in the Sonawani and Paraswara Ranges, smaller in size than usual, more fibrous, less juicy and less abundant, having assumed yellowish tinge in January which is two months earlier than usual

Gregarious seeding of the ordinary bamboo.

In the Motinala Sub-Range, which occupies the north-easterly part of the district, the ordinary bamboo (*Dendrocalamus strictus*) covering hill slopes seeded gregariously and the clumps dried outright. Three-fourths of the population of Raigarh found food in this seed for nearly 2½ months (15th January to the end of March 1900); nowhere else in the district did the bamboo seed in a gregarious manner.

Harra.

The yield of the harra fruit (*Myrobalans*) in the Sarekha-Bhaisanghat and Raigarh Ranges was most plentiful; the outturn being the largest during the last four years; the reasons for this over-abundance being:—

(*a*) The species had fruited very poorly during the year preceding.

(*b*) The trees having in stock a good deal of nutritive material in reserve from the preceding year were capable of producing larger quantities of fruit.

(*c*) Very little of the borne fruit could drop down on the ground due to the absence of heavy rains which,

* Vide also *Indian Forester*, Vol. XXVI., No. 7, page 336, and No. 10, page 504.

when accompanied by strong gales of wind, help its severance from the parent trees. The consequence of all this was that a very large proportion of the fruit remained adhered to the trees up to the very last.

Seeding of valuable timber species

Teak, sál, bija, tinsa, and shisham, are the only valuable timber trees in this district. Every one of these flowered and seeded poorly.

Yearlings and two-year seedlings.

Complete disappearance in every Range of one and two year seedlings off the surface of the ground was noticed. This was not, however, the case with the seedlings of the hardy palas (*Butea frondosa*). These flourished under and around the parent trees as well as in ordinary years—a fact widely noticeable in the Sonawani Range throughout the hot season.

Bamboos.

The reproduction by the rhizome was limited. The rhizomes received a sudden check in their development, owing to the abrupt cessation of the rains soon after they showed themselves; the culms produced remained lean, lanky and stunted. The bamboo on hills in Sonawani and Paraswara turned yellowish earlier than usual, that is to say, in its second year's growth instead of in the third year's, as is the case in ordinary years.

Growth of coppice shoots in compartments and certain shrubs.

Coppice shoots in compartments and small saplings of saj growing on gravelly and other poor soils betokened their suffering from drought as early as December by the drooping and wilting of their foliage. The following shrubs were conspicuous in this connection by their abundance:—

Vitex Negundo.
Grewia salvifolia.
Woodfordia floribunda.

Coppice shoots in compartments met with a protracted check in the development of their growth. The latter was on indifferent soils, in the majority of instances, almost half of that measured in the preceding year—3 feet to 7 feet height of shoots of garari (*Lebedieropsis orbicularis*), lendia (*Lagerstrœmia parviflora*), saj (*Terminalia tomentosa*), mokha (*Schrebera swietenioides*), tendu (*Diospyros Melanoxylon*), aonla (*Phyllanthus Emblica*), parar (*Stereospermum suaveolens*), katchnar (*Bauhinia purpurea*) being commonly met with.

Sucker reproduction.

Tendu sucker reproduction extensively found on abandoned cultivations seemed not to mind the drought at all. It flourished as in ordinary years

Production and growth of the grasses.

The Sonawani Range, received during the year, in all, six short showers, so that grass sprung up and made some progress in growth; but shortly after received a sudden check by the holding

off of the rains, so that it began to wither up; thus the cattle in the Katangi and Korolla parganas suffered most. In the Behir tahsil, as also the eastern part of Balaghat, more showers fell proportionately, favouring the production and growth of the grasses.

Leaf shedding.

Leaf shedding of deciduous species in forests growing on poor soils and dry hills, began as early as December. This circumstance was very noticeable in all the hill forests, as also in the Bichwa and Garaghat blocks and the Sonawani, Mow and Tippagarh reserves. Similar was the case with the bamboo.

Gums.

The production of gums was considerably less throughout the district. Every timber species growing in these forests shared the diminution.

Dying off of trees.

The death of several diseased and unsound individuals of teak was hastened in the Chachery reserve, and of sál, in the reserves of Kareli, Topla and Keoli Khapa, by the prolonged severity of the drought. Similarly, drought hastened, in many instances, the death of the diseased and dying individuals of the mixed species met with in the sál areas, the Sonawani and Paraswara Ranges; there being at present any number of dead trees standing about in these forests.

Formation of leaf mould.

Leaf mould could not be formed because of the continued absence of sufficient moisture in the upper layers and over the surface of the soil.

Ravages by insects.

Insect pests were practically none in any of these forests since rains which are an essentiality for forming food materials for them, were wanting.

Forests become highly susceptible to fires.

Forests fell an easy prey to extensive conflagrations due to the abundance of grassy and other refuse stuff on the ground, having become perfectly dry through protracted dryness and therefore more easily inflammable.

Frost.

Frost was very light during the year. It was observed in Raigarh (elevation 2,400 to 2,800 feet), which is under ordinary circumstances subject to heavy frosts for three months in the year, only nine days in January, the consequence being that the terminal shoots of sál plants escaped injury subjected to annually, and their foliage too escaped being burnt down. It may hence be assumed that they could, in a year of drought, manage to make progress in growth without the usual interruption.

Fever.

The forest tracts were admirably free from the usual malarious type of fever due to the paucity of the rains.

Forest products which provided sustenance to a large number of the poor inhabiting the proximity of forests.

As tendu, achar and mohwa failed, I have seen during the hot weather just past people eat the following as part of their food :—

(*a*) Young foliage of koilar (*Bauhinia purpurea* and *retusa*) boiled, a little salt, if available, added and eaten.

(*b*) Young foliage of the pipal (*Ficus religiosa*) prepared and eaten as koilar.

(*c*) Flower of the semal (*Bombax malabaricum*). The petals are dried and powdered, then mixed with the mohwa, boiled and eaten, or put in the flour of the bamboo seed, made into gruel, adding a little salt and then consumed.

(*d*) Seed of the kurloo (*Sterculia urens*). The seed is ground down and the powder mixed up with a sufficient quantity of mohwa, then boiled and eaten.

(*e*) Pods of the *Bauhinia Vahlii* roasted and the seeds eaten.

(*f*) Seed of the bahera (*Terminalia bellerica*). Kernel extracted and eaten.

(*g*) Fruit of *Gardenia turgida* (called *kharpendhra*) and that of *Randia uliginosa* (called *telpendhra*), whole fruit boiled, a little salt added and then eaten

(*h*) The ripe fruit of the bael (*Ægle Marmelos*) and of *Ficus infectoria* eaten largely. Fruit of other ficuses is gathered raw or ripe, boiled and eaten.

RAM CHANDRA KRISHNA,

Forest Divisional Officer,

Balaghat Division.

[Communicated by Mr. A. Smythies, Conservator of Forests, C. P.]

IV.—REVIEWS.

Our Forests and Woodlands

BY

Dr. JOHN NISBET, *I.F.S.*

The last published volume of "The Haddon Hall Library" (Dent) is *Our Forests and Woodlands*, by Dr. John Nisbet, I.F.S. (retired), late Conservator of Forest, Burma. The work is reviewed in the *Times* of September, the 10th, 1900.

Dr. Nisbet's book is a vigorous and persuasive plea for a more intelligent cultivation of "Our Forests and Woodlands" and a

lucid but not too technical exposition of the art and methods of forestry, preceded by a short introduction on "Ancient and Modern Forestry." We have much sympathy with Dr. Nisbet's plea for the more intelligent management of forests and woodlands, and all lovers of trees and woods will find abundant attraction in his pages; but it must, we fear, be acknowledged that he is better master of forestry than he is of economics. After giving statistics relating to the import of timber into the United Kingdom, he remarks:—"Making a liberal deduction for the value of labour included in these coniferous imports, aggregating over twenty-one million pounds, the undeniable fact is laid bare that Britain annually pays, and principally to foreign countries, no less than between eighteen and nineteen millions of pounds sterling for pines and fir timber which could quite well be grown in Great Britain and Ireland." That it could quite well be grown is probable enough; but that it could quite as well be grown is very doubtful indeed. We do not pay for the timber in money; we pay for it in manufactures. If we do not import the timber, we cannot export the goods which pay for it. What is the balance of gain and loss on the transactions, it may not be easy to determine, but it is just as difficult to determine whether we should gain or lose by growing the timber at home instead of buying it abroad. *Primâ facie* the presumption is that we should lose.

Malarial Fever and its Prevention.

1. *Instructions for the Prevention of Malarial Fever, for the Use of Residents in Malarious Places.*—University Press of Liverpool, 1900. Second edition Pp. 14.

2. *Report of the Malarial Expedition of the Liverpool School of Tropical Medicine and Medical Parisitology.* By Drs. Ross, Annette and Austen With suplementary reports. The University Press of Liverpool, 1900 Pages 47, Addenda, 5 plates and 4 maps. Eight illustrations in text. Price, 10*s*. 6*d*.

These two exceedingly attractive volumes are the first-fruits of what we hope may be a very rich harvest to be presently reaped by the Liverpool School of Tropical Medicine.

At last the Empire, with the greatest tropical possessions in the world, has become alive to her duties, and special schools for the study of tropical medicine have been established in London and Liverpool, whilst special teaching in the same subject is given in our own Edinburgh University.

Edinburgh may be said to have led the van in this subject, for ever since 1886 lectures on the diseases of the tropics have been given in the extra-academical Medical School, and last year the University itself instituted a course of lectures on tropical diseases.

The first memoir mentioned above, and which we have to notice, is an admirable yet short account of how to avoid malaria, that disease which slays its thousands and renders colonisation in the tropics almost if not quite impossible.

It is shown with *almost* absolute *certainty that one species* of mosquito the Anopheles—transmits the disease to the man. The question as to where the mosquito gets the malarial parasite is left severely alone at present; but we have to avoid getting bitten by these mosquitoes, and to destroy as far as may be their breeding-places, which are in small isolated muddy pools of stagnant water.

To summarise the exceedingly useful information given in this pamphlet would hardly seem to be justifiable, but every individual going to the tropics would do well to buy and read, and obey this most useful and *indispensable booklet*

This Journal is hardly the place to review in any detail the second memoir. It is an account of the malarial expedition sent, under the leadership of Dr. Ronald Ross, to study the malarial question on the West Coast of Africa.

The expedition was most successful in finding the special mosquito and its breeding-pools. An elaborate account of the whole subject is given, which will prove of the greatest use to all Medical men, to whose special attention we commend it. We warmly congratulate the Liverpool School of Tropical Medicine on its enterprise and on its present success, and very cordially wish it still greater success in the future.

The illustrations and micro-Photographs are all that could be desired; and, as indicated above, both memoirs are very admirably produced. -*The Scottish Geographical Magazine.*

Photo by W. H. Craddock, F D

PAPER MANUFACTURE IN THE S. SHAN STATES, BURMA.

THE

INDIAN FORESTER.

Vol. XXVI.] December, 1900. [No. 12

Paper Manufacture in the Southern Shan States, Burma

The paper mulberry (*Broussonetia papyrifera*) is largely cultivated in the State of Kenghkam for its fibre, which is made into paper locally. In the dry weather there are no crops to tend and the villagers have little or no work to do, so they turn their hands to paper-making, and a very profitable employment it appears to be. A short account of the way in which the paper is made may be of interest. The bark is peeled off the trunk and branches in lengths of about 5 feet, the outer bark or cortex having been previously scraped off. These strips are hung out in the sun to dry and bleach for a couple of days or more, and are then immersed in a cauldron containing a mixture of water and wood ashes and allowed to simmer over a slow fire for from 6 to 12 hours; this softens and disintegrates the fibres. The mass is then washed in several changes of water and pounded with mallets on a slab of wood until it is reduced to a pulp; all impurities, such as knots, pieces of straw, &c., are now picked out, and after a further pounding and washing the pulp is made into balls of about 3 inches diameter and is ready for the next operation—its conversion into paper. This takes place in an open shed fitted with a shallow wooden trough, 6 feet by 3 feet and 2 inches deep, supported on legs like a table. This trough is filled to a depth of ¾ of an inch with water, and in it is placed a tray, the size of the intended sheet of paper, generally 24 inches by 28 inches and 1½ inches deep, the bottom of which is of coarse country cloth, which acts as a sieve and lets the water from the trough into the tray. A ball of pulp is next taken and put into a bamboo tube, a foot long, together with some water, and the whole is churned up with a pronged stick; the resulting mixture is emptied out into the tray which already has water in it. The pulp is spread over the tray with the hand and the surface is lightly tapped with a flat piece of wood or bamboo to make it lie evenly; this it does the more easily as its specific gravity is about the same as that of water. The tray is then gently lifted out of the trough, the water

percolating through leaving a deposit of pulp, and is left inclined against a support for quarter of an hour to enable the superfluous water to drain off, after which it is put out in the sun to dry. When about half-dry, the surface of the pulp is rubbed over evenly with the rim of a glazed earthenware cup; this answers the purpose of "sizing." When thoroughly dry it is peeled off the bottom of the tray by means of a polished piece of hard wood, shaped something like an ordinary paper-knife. It is then folded in two and packed for the market. The above is the method employed in making the ordinary writing paper of the Shans. There is a thicker and coarser variety resembling felt, which is made in a similar manner and is used for mats and packing. This is sometimes made waterproof by smearing over bees'-wax and crude petroleum. "Palabaik," the black multifolding note-book of Burma, is also made from the bark of the *Broussonetia papyrifera.* The surface is coated with powdered charcoal and rice-water, to allow of it being written on with talc pencils.

Specimens of Shan paper and a photograph illustrating its manufacture are enclosed herewith.

W. H. CRADDOCK.

[Through the courtesy of our contributor we are enabled to attach a specimen of the Shan paper above described. It would be useful if Mr. Craddock would supplement his interesting note with an account of the method of cultivation employed, whether the plants are grown from seed or coppice, age and time of year at which utilized, etc.—HON. ED.]

Imperial Institute Quarterly Report.

Quarterly Report on enquiries conducted for the Government of India, in the Scientific and Technical Department, by Professor WYNDHAM R. DUNSTAN, *M.A., F.R.S., Sec. C.S., Director of Scientific and Technical Department of the Imperial Institute.*

Having in my Annual Report, dated May 1st, 1900, on the investigations conducted for the Government of India during the past year, given an account of the progress of these enquiries, I have little to add at the present time.

The investigations there referred to are in progress and work has been commenced on several materials recently received from India notably certain juices, more or less allied to rubber and on the gum of *Prunus eburnea*, which seemed likely to be useful as a substitute for gum arabic.

A memorandum on the present position of artificial indigo having been drawn up by me at the request of the Commercial Intelligence Branch of the Board of Trade, a copy has been forwarded to the India Office for purposes of reference, and it is hoped that the suggestions there made, as to the desirability of scientific investigations being conducted into the production and manufacture of indigo, may receive the favourable attention of the Government of India.

A number of enquiries from commercial men as to the possibilities of obtaining supplies of several Indian products which have

been reported on by this Department, have been replied to, and the attention of the Reporter on Economic Products directed to them.

A large number of materials collected in India under Dr. Watt's direction still await investigation, but the principal members of my staff being already engaged with Indian enquiries, it is not possible for me at the present, without further assistance, to take up any of the subjects which have been recently referred to this Department.

(Sd.) WYNDHAM R. DUNSTAN,

Director, Scientific and Technical Department.

12th July 1900.

Notes on the Wood-Working Machinery Exhibits, Paris Exhibition, 1900.

Machines for Breaking Down Logs in the Rough.

As time goes on we shall see in England more and more attention being paid to machinery for dealing with logs which have already been roughly squared, and proportionately less notice being taken of machines for breaking down round logs; as the amount of log sawing in England from native timber is not large, and will be still smaller owing to the supply being limited.

There is, too, a disinclination on the part of the exporters on the one hand, and of the importers on the other, to pay freight on a quantity of bark and sap from the outsides of logs, brought to England in the rough from other countries, which is in most cases useless to them.

Perhaps one of the greatest revolutions which has taken place in wood-working machinery of late years is the substitution of band saw machines for log frames, and circular saw rack benches for breaking down logs in the rough, especially logs of the larger sizes. This is easily accounted for, as not only by the use of the first-named machines is there an enormous saving in wood in the saw cuts alone—the band saw being of a very much smaller gauge than those employed in using log frames or saw benches—which is a very great consideration where the more expensive kinds of wood are being sawn, but in cases where there are flaws in a log which are undiscernible before one or more cuts have been taken, the log can often be so handled as to get the very utmost out of the faulty timber, and this is, of course, impossible where log frames are in use, as one can never tell the exact condition of a log until it leaves a log frame as sawn timber. Besides the above advantages, when sawing planks, etc., with a band saw, cuts of different thicknesses can be taken, with practically no loss of time, each time that a cut is taken.

In the above connection I append details of a few cuts made by a patent horizontal band saw machine manufactured by A. Ransome & Co., Ltd., of London and Newark. This is the result of three hours' regular work, including the necessary stoppages for changing saws and putting on logs. The machine was worked by one man, while two labourers removed the sawn boards as they were cut, and assisted in fixing the unsawn logs on the carriage.

	Superficial feet of Sawing.
An elm log, averaging 33in. diameter by 14ft. 4in. long, cut into 27 one-inch boards and two slabs in 40 minutes ...	899
A white wood log, 28½in. square, 16ft. 5in. long, cut into 51 half-inch boards in one hour	1,989
A mahogany log, 15in. square by 20ft. 7½in. long, cut into 19 boards of various thicknesses	492
An oak wainscot log, 12in. by 18in. by 13ft. 7in. long, cut into 17 one-inch boards	232
A kauri pine log, 18in. square by 15ft. 2in. long. Six half inch boards only were cut from this log.	137
Total production in three hours in superficial feet ...	3,749

In connection with the above, I think it well to point out that every board produced was straight and flat, and of even thickness throughout, and the surface practically smooth.

With regard to the power required to drive band saw machines, I think it well to state that a properly constructed band saw machine requires vastly less power to drive it, in proportion

to the amount of work it turns out, than any other description of log-sawing machine. With a view to making this clear, I give a table showing the indicated horse-power actually taken by a horizontal band saw when sawing Java teak, 16 inches square, into half-inch boards, with various rates of feed. It should be borne in mind that teak, although not the hardest wood in the world, is by far the most difficult to cut.

From the above it will be seen that when cutting Java teak with a production of 68 superficial feet of sawing a minute (which I consider to be nearly its full capacity in teak), the machine required $43\frac{1}{2}$ net indicated horse-power to drive it, and as most modern engines indicate three times their nominal power, I advise an engine of 20 nominal horse-power for driving one band saw with its saw-sharpening machine. When, however, it is used for sawing in the forest where the timber is recently felled, and the saw would be driven direct from the flywheel of a portable engine, both the saw and the sharpening machine could be easily driven by an engine of 16 nominal horse-power.

In short, the above remarks may be summed up as under:—

The advantages of really well-made log band saws have been proved beyond doubt by the following striking facts:

1. That they will cut as fast as the best circular saw mills, while wasting only about a quarter as much wood in each cut and taking considerably less power.

2. That as compared with vertical frames they will do vastly more work besides saving a great amount of time in shifting the saws. They offer the further advantage of making one cut at a time, thus allowing the sawyer to see how the log is developing, and enabling him to convert it to the greatest advantage.

3. That as compared with the horizontal or single blade frames they will turn out more than ten times the amount of work.

Great improvements have latterly been made in both horizontal and vertical log band saws, more especially in the former, in connection with feed gear and driving arrangements, and in the manner of manipulation with a small amount of labour.

Deal frames are, in my opinion, being gradually superseded by power-fed band sawing machines, or (as the Americans call them) "band re-saws," and saw benches with ground off saws.

One of the most important additions of recent years with regard to saw benches is the growing use of the vertical roller feed applied to this class of machine, which gives a much straighter and more uniform cut than can possibly be arrived at by hand, besides getting a considerably larger output from the machines and effecting an immense saving of manual labour.

The exigencies of the Factories Act have brought out a good many new guards for circular saws, etc., some of which are ingenious; but the average sawyer is very conservative in this respect, and will not use a guard of any sort if he can possibly avoid doing so.

Four-Cutter Planing and Moulding Machines.

With regard to the above, one of the tendencies of the age is the inclination towards the general use of cone bearings for the cutter blocks when these are desired to be driven at very high rates of speed.

One of the chief advantages of these bearings over the ordinary parallel type is the ease and speed with which any play caused by wear and tear of the bearings can be rectified, without recourse to a skilled fitter. The tendency with the best makers of moulding machines is to have the last cut made by the top cutters, all the truing up work having thus been completed before these—the most important cutters of all—come into operation, by the bottom and side cutters. In moulding machines weight pressures seem to be rather the more favoured than spring pressures among most users.

For tonguing and grooving floor boards, etc., circular bit cutter blocks are increasing in popularity, and of these the most practical I have seen are the Ettinger's patent expansion circular bit cutter blocks, combining, as they do, the strength and simplicity of a solid flange head with all the advantages of expansibility, from the nature of their construction. One of the best manufacturers of planing machines uses India-rubber pads at the ends of his cutter-block spindles.

These machines can now generally do a very much greater output with the same amount of horse-power than was the case a few years ago, owing, amongst other improvements, to the attention which has been given to the arrangements of the feeds and the tempering of the cutters, especially in moulding machines.

Among the usual joinery machines I am unable to find any striking novelty, although, in this connection, the English and American firms exhibiting are the most up-to-date in small details which have been improved. The French exhibits are not of any great account, with the exception, perhaps, of those of Panhard Lavassour, who has one or two machines worthy of notice; but this does not influence the average buyer, as wood-working machinery made in France very seldom leaves the land of its birth. Most of the German machines of this class bear a strong family likeness to some which are made by English and American exhibitors.

The Americans have a few machines suitable for bridge-building and other heavy work, notably a big hollow drill mortising machine, and a drilling machine for drilling holes at any angle and up to $4\frac{1}{2}$ inches in diameter at a great speed.

Fay and Egan also have an excellent dog feed double tenoning machine. The above are all more or less new.

Perhaps the most striking novelty of the times in wood-working machinery is the "Marbut" carving machine.

In joinery machines, as in other machinery with which I have dealt, there is a marked increase in the rapidity with which work

can now be turned out, owing to the attention which has been *given to minor details.*

Every one who has had any experience, however small, of saw mill work, knows how much depends on the *quality and condition* of the saws and cutters with which they have to deal; and I have never seen a more perfect exhibition of this material than is being shown by the Simonds Manufacturing Company of America.

No. of Trial.	Nature of Work.	Width of Log.	Feed in feet per minute.	Superficial area per min. in feet.	Remarks.	I.H.P., including Engine.	I.H.P. used by Band Saw.
1	Engine and Shafting ...	...	...	...	all belts on loose pulleys.	15·5	...
2	Ditto, saw running ...	...	...	...	Not cutting	23·8	8·3
3	Cutting Java Teak ...	16 in.	11¼	15	True cutting	37·4	21·9
4	Ditto ...	16 in.	20	26⅔	Ditto	41·4	25·9
5	Ditto ...	16 in.	27¾	37	Ditto	43·3	27·8
6	Ditto ...	16 in.	36	48	Ditto	51·9	36·4
7	Ditto ...	16 in.	51	68	Ditto	58·3	42·8
8	Ditto ...	16 in.	51	68	Ditto	59·0	43·5

In the above trials the saw employed was 4 inches wide and No. 18 W. G. slack.

Among other tools they have a band saw for log sawing, with teeth both on back and front, and thus a cut can be taken when the log is on the return journey; the output of a machine adapted to the use of these saws being in this way increased by practically 100 per cent. And as an instance of what can be done by these saws, I may quote the following:—Ten boards, 16ft. long and 10in. to 14in. in thickness, have been dropped from a log in 27 seconds! A truly marvellous rate of production!

The circular saws with movable teeth shown by the same company are as good, of their kind, as can be. By using these inserted teeth one stops all possibility of the saws getting out of their original round, a thing which saws are very wont to do if subjected to careless sharpening. The inserted teeth are so made as to give a cut resembling that of a chisel. The day of these saws, for a certain class of work, is coming, there being an ever-increasing demand for them.

There are in the Exhibition, in the French Section, some weird-looking frame saws, with teeth sticking out at all sorts of angles. My experience of these "cut-every-way" teeth, for practical work, is that they do not turn out nearly such good sawing as the straightward type of saw, with the one form of tooth throughout, and that they require at least ten times the amount of care in sharpening and setting, etc.

Saw-Sharpening Machines and Cutter-Grinding Appliances.

From what I have seen in this Exhibition I am inclined to think that very little headway has been made in connection with these machines during the past ten years, except perhaps in the tools for sharpening and setting band saws, the chief reason for this being that saws in particular need such an enormous amount of care, that any machine which "tries to do too much" is worse than useless in this connection.

There are some automatic machines in the Exhibition for sharpening circular saws, which "sharpen" each tooth in succession, giving the required angle to each tooth, and these machines have elicited an immense amount of admiration from unpractical people, and there is no denying that they are very pretty "show machines"; but they would, in my opinion, prove a veritable nightmare to any foreman of a saw mill who had to depend on these machines alone for the satisfactory upkeep of the condition of his circular saws, after they had run for a short time, and I do not prophesy anything of a future for these machines as a marketable article. After a good look round I retained the same conclusion as I have had for years—*viz.*, that for circular and frame saw-sharpening and for cutter-grinding, the ordinary saw-sharpening machine—with an emery disc, pulled down to its work by hand at any angle which is required—for the former, and the automatic cutter-grinder with an emery cup, cutting on one edge of the cup only, for the latter, have a long life before them yet.—*Engineering Times.*